

# NEW TECHNOLOGY JAPAN



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## INNOVATIVE PRODUCTION NOW

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Small-Lot Production of Flavorings  
and Seasonings – Shizuoka-Kanaya  
Plant of Fuji Foods Corp.–*

## NATIONAL R&D PROJECTS

*Wide-Area Energy Utilization Network  
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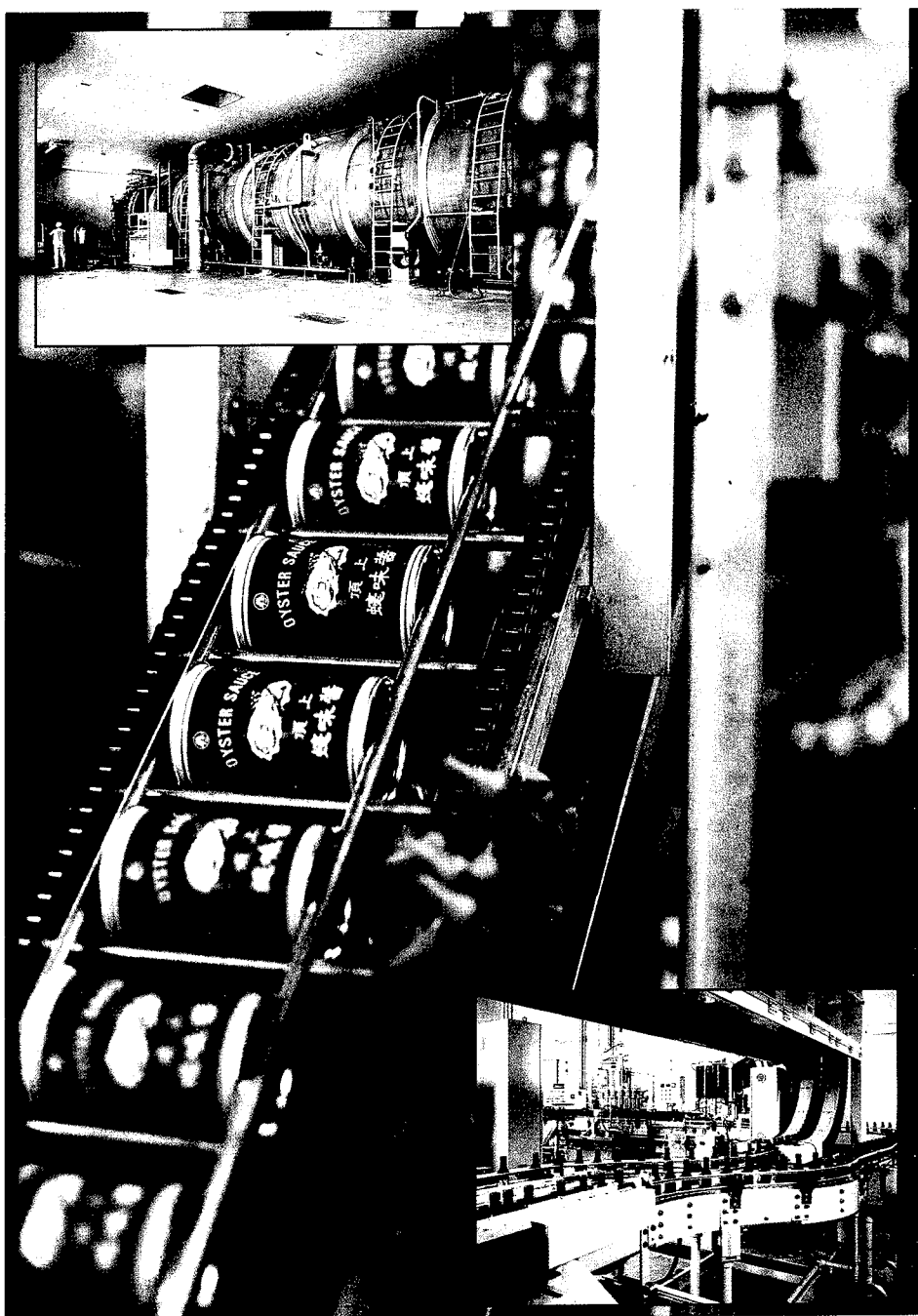
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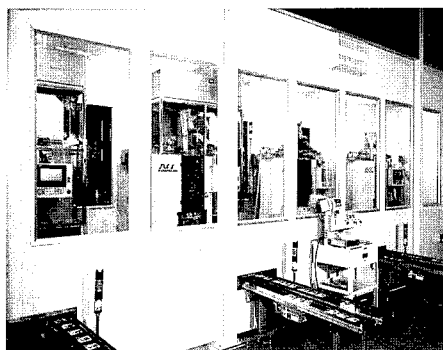
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–Present Set Top Boxes and  
Future Outlook–  
Digital Archives in Japan  
Colour Management in Multimedia  
and International Standardization*



JETRO

*The aim of our magazine is to promote the international exchange of technology through the introduction of Japanese New Technology.*



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**Cover Photo:** Modernized Plant for Multi-Product/Small-Lot Production of Flavorings and Seasonings – Shizuoka-Kanaya Plant of Fuji Foods Corp.– (Story on Pages2-4)

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# INNOVATIVE PRODUCTION NOW

*This section describes a specialized section or whole process of a representative factory which excels in specific aspects of production.*

## *Modernized Plant for Multi-Product/Small-Lot Production of Flavorings and Seasonings —Shizuoka-Kanaya Plant of Fuji Foods Corp.—*

### 1. Introduction

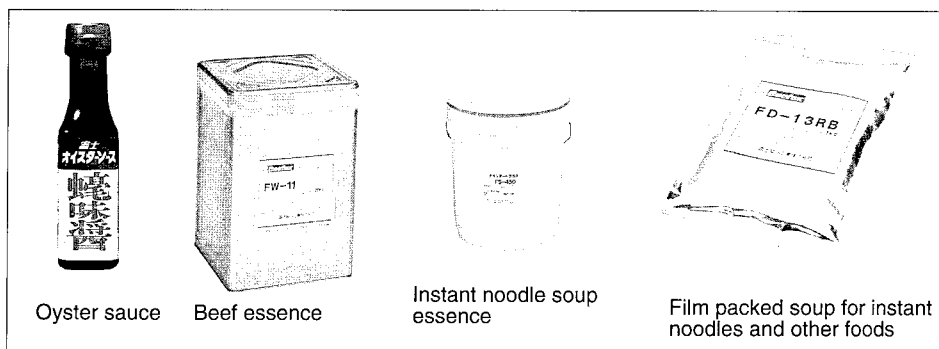
The eating habits of the Japanese people have undergone a rapid and drastic change in recent years due to the development and wide use of various types of precooked foods, flavorings and seasonings, and retort foods as well as the proliferation of fast-food shops and restaurants in all areas of cities and towns as well as along expressways and main traffic highways. In fact, the Japanese people now consume huge volumes of various types of foods as well as flavorings and seasonings in the home and in eating establishments.

In concert with this trend, the ratio of eating-out expenses to the total food expenditures of general households has increased steadily during the last several years, and FY 1995 statistics revealed that eating-out expenses accounted for over 16% of total household food expenditures. Experts estimate that the total food market scale is about ¥75 trillion, consisting of a food retail industry market value of ¥46 trillion and an eating-out market value of ¥29 trillion. The total food retail market value is further broken down into a fresh food market value of ¥16 trillion and processed food market value of ¥30 trillion. Roughly 20% of the eating-out market value consists of the commercial processed food market.

The cost ratio of flavorings and seasonings in the total cost of procurements of various food ingredients by the eating-out industry is 4-5%, and when general households are included, the cost ratio falls slightly, but since these flavorings and seasonings hold the very key to determining the character or taste of foods, flavorings and seasonings such as sauces



*The modern Shizuoka-Kanaya Plant*



*Typical products of the Shizuoka-Kanaya Plant*

and spices play the main supporting roles in the preparation of delicious foods.

Meanwhile, in this age of culinary variety, a wide difference has arisen in personal and regional taste, and competition between eating-out establishments, so that the need for flavorings and seasonings is diversifying to achieve taste differentiation and to establish distinct characteristics in the foods served by various food service

outlets. This means that the manufacturers of flavorings and seasonings must achieve a transition from the conventional mode of mass production to the mode of producing various products in small lots.

This issue introduces Fuji Foods Corp.'s modern Shizuoka-Kanaya Plant that was completed in 1990, commissioned into service in October and started full-scale manufacture of various types of



*Large canned product packing line*

flavorings and seasonings in small lots in November of the same year. Fuji Foods was the first in Japan to develop powdered shoyu and miso, and has established a strong presence in the manufacture of oyster sauce, noodle soup, soba and udon sauce, flavorings and seasonings for Chinese and western foods, and beef, chicken and pork essence, for supply to general households, eating-out and food service establishments as well as food processors.

## **2. Description of Shizuoka-Kanaya Plant**

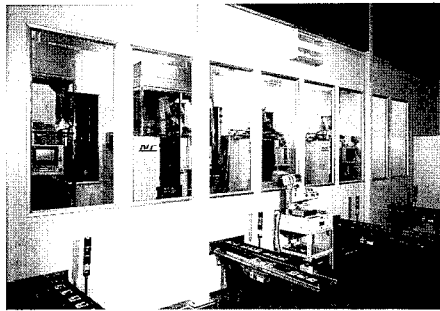
### **(1) Description of the Plant**

The plant is situated in Ushio, Kanaya-cho, Shizuoka Prefecture, about 10 min ride from Kanaya Station that can be reached in about 2 hrs from Tokyo by local rapid express Shinkansen and JR Tokaido Line. The site is about 39,000 m<sup>2</sup>, and the building is a two-storied steel skeleton structure with an aggregate floor area of about 12,560 m<sup>2</sup>.

The inside color is coordinated in white, the 1st floor accommodates all the manufacturing facilities, packing and packaging facilities and drying facilities, and the offices. As with recently designed plants, it is equipped with a neat passageway for the plant's clients and sightseeing visitors. An audio-visual room equipped with video systems and projectors offers presentations to visitors and businessmen. An average of 500-600 sightseers visit the plant annually. The plant is operated by about 100 workers, or 80 employees and 20 part-time workers. It is operated for 230 days annually under a single-shift system, except for the boiler section.

### **(2) Products**

The plant's main products include its branded oyster sauce, noodle soup and essence, beef essence and various types of stocks for addition into foods, which are filled or packed into polyethylene bottles, cans, retort packs or packaging films.



*Full automated facilities produce a wide array of products*

Another line includes the private brand products which are manufactured in conformance with the plant's specifications and in the grade required by its clients. The plant manufactures an average of 570 different types of products annually, which come in liquid, paste and powder form.

### **(3) Production Capacity and Facilities**

The daily production capacity, when the plant is operated continuously, is 80 ton of products, but since time is required for making preparations to engage in the manufacture of the next product, the plant is presently operated at a daily production capacity of 60 t.

The main production facilities consist of 21 units of steam cookers (1 ton each), a continuous vacuum drying line, a filling and bottling line, a canning and retort line, a soup filling line, a liquid and paste products production line and an upright-pouch line. The necessary steam is supplied with a 2 t/h boiler.

The central production facility is the continuous vacuum drying line, which is one of only four units installed and in operation in Japan. The superhigh-speed belt dryer line with an overall length of 16 m has a maximum drying capacity of 500 kg/hr, and is used to manufacture beef essence from raw materials supplied by factories operating in the United States. The oyster sauce filling line operates at a fast speed and packs 120 g of essence into

150 containers/min. All these facilities were produced by various machinery manufacturers, and the functions and specifications matched to the plant's production system.

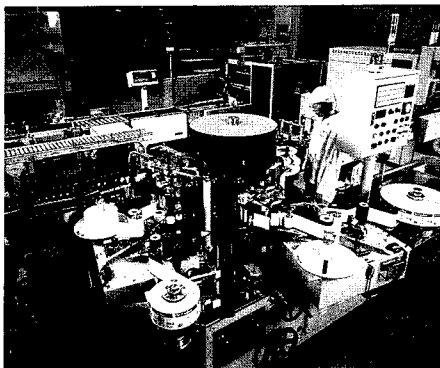
### **(4) Adjustment of Raw Materials and Packaging Materials**

The food processing industry uses natural raw materials, so the quality levels of these raw materials directly influence the quality levels of the products. The Shizuoka-Kanaya Plant accepts only raw materials which fully comply with its preset selection standards, and uses only those which pass the various tests and inspections which are conducted. Except for a small portion, most of the raw materials are made in Japan. For example, oyster essence extracted from oysters cultured under consignment in Hiroshima, a famous oyster production center in Japan, is used to produce the oyster sauce. Tests have fully corroborated that using Hiroshima oyster is optimum for producing oyster sauce. The raw material beef essence is imported from a factory the company built in North Carolina (U.S.).

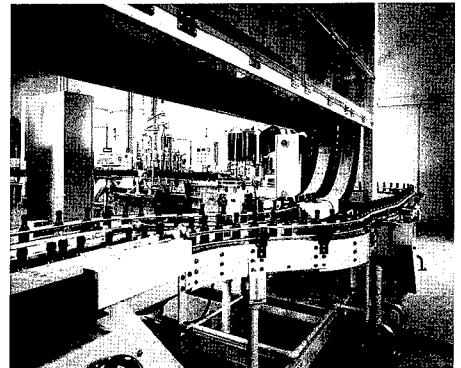
Thus, the plant uses raw materials which are fresh and optimum for manufacturing its various products. Meanwhile, the plant uses a huge quantity of polyethylene bottles, cans, retort pouches, films, packaging materials and corrugated board cartons of various sizes, which would ordinary require a gigantic storage facility, so it adopts the unique method of producing only the volume equivalent to one day's consumption.

### **(5) Production Volume and Production Expertise**

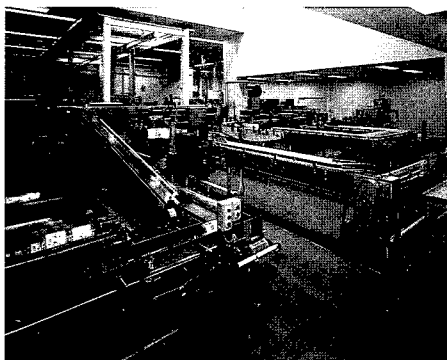
The plant manufactures various types of products in conformance with the recipe prepared by the Head Office's Research and Development Department. The company's own brand products and private brand products ordered by clients are manufactured. The own brand



*Automatic labeling line*



*High speed oyster sauce filling & packaging line*

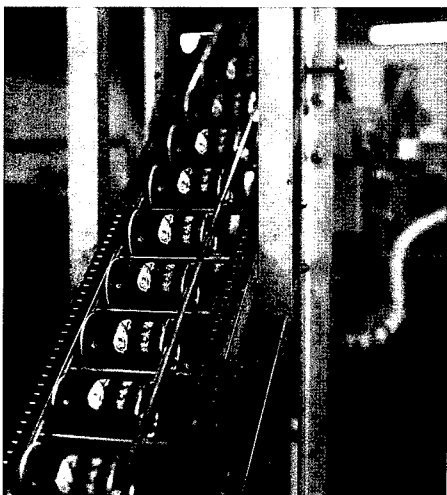


Product sorting line

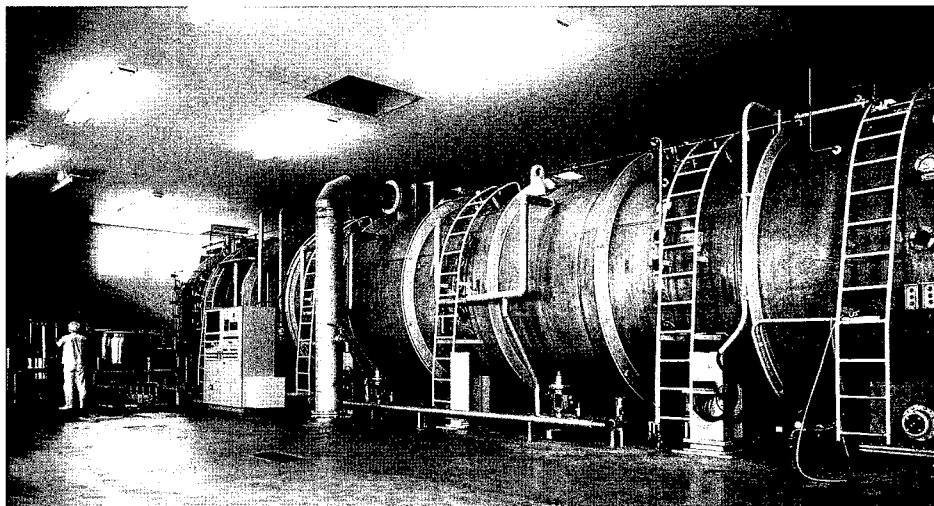
products consist mainly of commercial products for supply to the eating-out industry or to restaurants and enterprises serving fast foods, instant noodles and other foods. More recently, demand has been increasing for commercial private brand products ordered by mass sales retail outlets such as convenience stores and supermarkets as well as by the restaurant trade. Production between the cookers and filler is achieved by the batch system, and production beyond the filling process by the continuous system.

Since products have become highly diversified in recent years, steam cookers with unit capacities of 1 t are used, and production achieved at a rate of 60 batches per day and 60 tons of products daily. These steam cookers are aligned in a special chamber, independent of the filling and packaging lines. The filling and packaging lines are maintained in a dry state without wetting of the floors as is common in ordinary food processing plants, and the greatest caution is paid to sanitation and safety.

The most vital technical expertise in the manufacture of flavorings and seasonings concerns the techniques to control the temperature, pressure and the period of processing time. At this plant, the steam-



200 pieces/min. capacity canning line

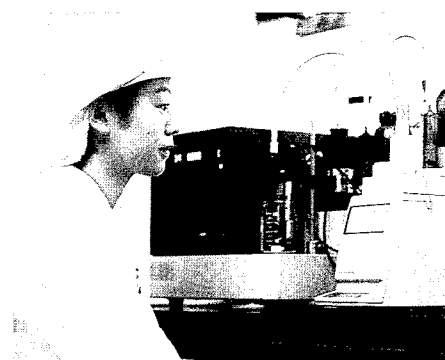


16 meter long vacuum type continuous dryer with capacity of max. 500 kg/h

ing and drying processes are conducted by using steam, and products of uniform quality are produced due to the establishment of optimum heat administration technology. Finished products are shipped out with trucks, and almost the entire volume of products manufactured in a day is shipped out on the same day.

#### (6) Research and Quality Control Departments

The Shizuoka-Kanaya Plant maintains its own R&D Department, separate from that of the Head Office. The main objectives of this department are to analyze the supplied raw materials to judge whether they are usable safely as the raw materials for its products, and to inspect the quality levels of its intermediate and final products in each of the manufacturing stages, so this department holds the key to whether the plant can supply quality products. Since various



Inspection, testing and quality assurance in the laboratory

types of analysis, inspection and evaluation systems are employed in conjunction with the manufacturing system, tests must be performed as quickly as possible to prevent any obstruction to production schedules. Therefore, the department is being developed from year to year and presently maintains as many as ten experts specializing in various fields of technology.

### 3. Postscript

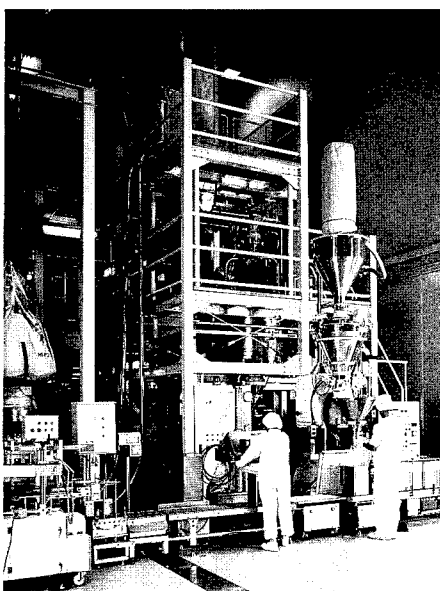
The Shizuoka-Kanaya Plant has achieved optimum coordination in order to manufacture various products in small lots using the concept of automation that is the basis of mass production, resulting in a most modern and efficient food product processing plant.

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Front view of cooking equipment

# NATIONAL R&D PROJECTS

*This section describes various R&D projects being carried out in Japan on a national scale.*

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## *Wide-Area Energy Utilization Network System Project (Eco-Energy City Project)*

### 1. Project Background

Japan is one of the world's leading consumers of energy and relies on imports for about 80% of the necessary primary energy resources, so acquiring stable supplies of energy resources influences the country's very viability. Therefore, with the primary oil crisis of 1973 as the turning point, the government and the general public made great efforts for energy conservation, so that the energy efficiencies of the country's systems and equipment, industrial plants and enterprises attained the world's top level. However, further energy conservation is required due to the emergence of global environmental issues and the predicted shortage of energy resources due to the rapid increase in energy consumption by rising Asian countries.

A survey of energy supply and demand in Japan shows that low-temperature waste heat lower than 200 °C generated in huge volumes by industrial plants is not utilized effectively since there is no special use for low grade heat within these industrial plants. Meanwhile, in urban regions where a massive demand is being raised for comparatively low-temperature heat for use in interior cooling and for producing hot water, the energy consumption volume is rising and raising environmental disruption issues represented by the heat island phenomenon.

The Wide-Area Energy Utilization Network System Project (the Eco-Energy City Project) is an integrated technology development project with the objectives of recovering industrial plant heat and urban waste heat, to transport the heat efficiently regardless of the distance and to utilize the heat most efficiently and effectively by advanced methods, thereby establishing an integrated energy-conservation, environmentally harmonized urban energy system.

A futuristic energy-conservation type, environmentally-harmonized type city should be based on an integrated system not only for recovering and utilizing untapped energy resources

and also involve systems for recycling waste water and wastes, and a power supply system including distributed type power plants, and this project is designed to play a major role in the realization of such a futuristic city.

### 2. General Description of the Project

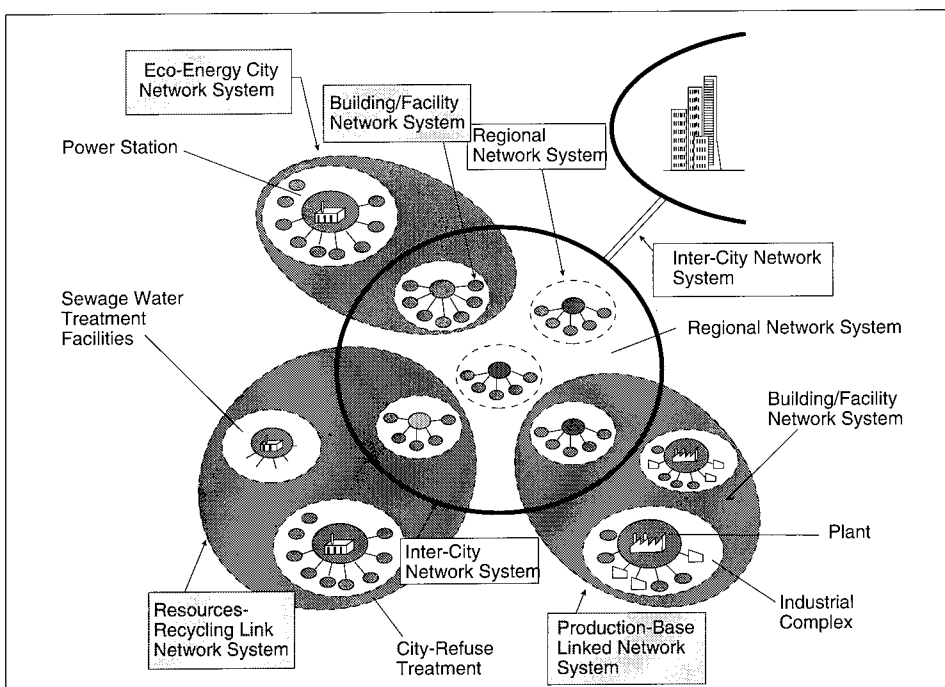
The image of the futuristic city to be realized by the Eco-Energy City Project, as shown by the accompanying figure, is a city with stratified network systems lying on the independent building level, regional level and inter-urban level. For the realization of such an integrated energy system, it will be necessary to develop basic energy-related technologies for energy recovery (possibly through transformation), and for the transportation, storage, utilization as well as the peripheral technologies to back up these operations.

To develop these technologies, it will be necessary to improve the efficiencies and lower the costs of existing technologies, and to create in-

novative technologies relating to entirely new systems, so it will be imperative to establish optimum total systems coordinating these basic technologies, to probe for technological seeds and to establish systematization technologies. The technologies to be developed through this project in connection with various fields consist of the following.

#### (1) Technology for Recovery of Untapped Energy Resources

This technology will recover waste heat of all levels from low temperature to high temperature, from individual buildings to the city as a whole, or from independent industrial plants to entire industrial regions. In this project, research will be advanced to establish technologies to recover heat as heat, technologies for recovering the gases generated by methanol decomposition, technolo-





gies for recovering hydrogen pressure, and technologies for recovering electricity.

## **(2) Technology for Untapped Energy Resources Transportation and Storage**

In this project, technologies will be developed to transport recovered heat efficiently in the form of methanol decomposition gas and hydrogen gas. This method of transporting heat through chemical heat conversion has the advantage of high-density and room-temperature transportation of energy, and the possibility of heat storage and temperature conversion, so advanced technologies may enable some existing energy transportation technologies to be replaced with more efficient technologies.

## **(3) Technologies for Utilization of Untapped Energy Resources**

Research will be advanced to develop energy utilization technologies permitting heat to be used in a wide range of utilization in urban regions, such as a heat supply system utilizing heat generated in the process of re-synthesis of methanol from methanol decomposition gas, a wide-temperature heat supply system generated through direct combustion of methanol decomposition gas, a heat supply system and heat pump utilizing hydrogen pressure, heat pump technology enabling pump operation at a lower temperature than before, and technology to efficiently supply generated cold and hot heat.

## **(4) Basic Peripheral Technologies**

The technologies to be developed are those necessary for computing and evaluating optimum heat control systems and environmental load decrement effects. Presently in progress is the development of a technology for non-contact measurement of the flow rates of turbid fluids utilizing the laser Doppler effect.

## **(5) Systematization Technologies**

Research will develop systematization technologies or technologies for coordinating evaluation techniques, optimum designs and the infrastructures of existing societies. In progress now are the development of systematization and evaluation technologies, state of waste heat and heat demand survey technologies, and advanced basic technologies for wide-area utilization of energy resources.

# **3. Technology Development Schedule and Setup**

The R&D project is being advanced by the New Energy and Industrial Technology Development Organization (NEDO) with subsidies provided by the Agency of Industrial Science

and Technology, Ministry of International Trade and Industry. NEDO is consigning the development of systematization technologies directly to private enterprises, while the development of basic technologies is being consigned to the Energy Conservation Center that further re-consigns projects to its more than 40 participating enterprises active in the fields of iron & steel, chemicals, gas, construction, electrical machinery and industrial machinery, including overseas R&D organizations.

In addition, seven research institutes belonging to the Agency of Industrial Science and Technology are engaged in joint research with consigned enterprises in connection with principal basic technologies, and national institutes are supporting these projects by engaging in basic and supporting research (National Research Laboratory of Metrology, Mechanical Engineering Laboratory, National Institute of Materials

and Chemical Research, National Institute for Resources and Environment, Government Industrial Research Institute Osaka, Government Industrial Research Institute Hokkaido, and Government Industrial Research Institute Kyushu).

This project was commenced in FY 1993 and is providing a steady stream of excellent results, and an interim evaluation of the present state of the project progress is presently underway. The project involves the development of many technologies demanding innovative technological breakthroughs, as well as technologies which are quite versatile and require commercialization at comparatively early stages. Further, the future plan is to include various technological development themes indispensable for the realization of an eco-energy city system from overseas organizations for inclusion into the project, and the cooperation and participation of a broad scope of research and development organizations is anticipated.

## ***Distributed Type Battery Power Storage Technology***

The objective of this R&D project is to develop a high-performance lithium secondary battery technology, specifically a stationary type storage system (home load equalization system) and a mobile type storage system for electric vehicles (with the emphasis placed on energy conservation in the field of transportation as well as on suppressing the adverse influences imposed to the environment), which can be anticipated to contribute to resolving global environmental disruption and energy-related issues.

This project was started in FY 1992 and since the technological progress of the lithium secondary battery was unclear at that stage, research was advanced primarily with emphasis placed on developing technologies which would evaluate the high-performance lithium secondary battery, also identify the reliability of the performance of the lithium secondary battery. Later, basic technologies relating to 10-Wh class unit batteries were developed up till FY 1995, interim evaluation was conducted, and technological evaluation was advanced to shift to the development of large (100-Wh class) lithium secondary batteries.

Since it became possible to fabricate unit lithium secondary batteries of several hundred watt-hour class as a result of research efforts, expectations were raised for the early establishment of a power load equalization technology based on the lithium secondary battery utilizing cheap late nighttime electricity, and automotive manufacturers and other organizations increased

their interest in the lithium secondary battery under development through this project, so detailed user-side specifications have been developed to meet the needs of applying the battery to electric vehicles, so an enthusiastic environment have been established in connection with this research project.

The existing project state was reassessed in the following directions with the objective of improving the basic project plan:

- (1) Development of stationary type and mobile vehicle type battery modules of high technological perfection as the commercialized modules based on the needs of the electrical and automotive industries which are placing great expectations on the results of this research project, and
- (2) The addition of essential themes in the stage of the lithium secondary battery commercialization, such as the battery safety, recyclability and other technical attributes.

A general description of the new basic project plan (draft) is shown in the Table 1.

The method and themes for advancing the R&D project beyond FY 1997 were revised as follows:

- (1) Analysis and research of the influences exerted by the battery under development on the natural environment in all its stages from

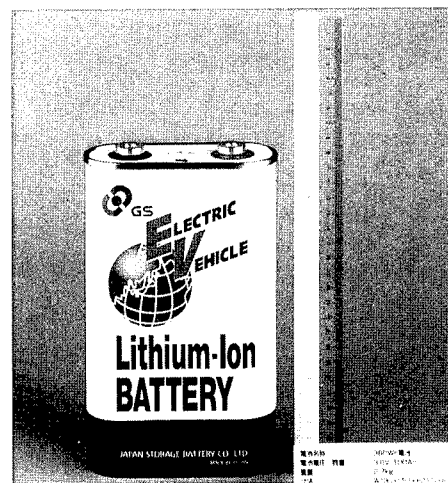


manufacture to waste treatment (life cycle assessment), as well as research conducting to the battery safety improvement.

- (2) Battery safety research will be advanced more intensively due to the battery's importance, and research and development results will be announced openly both domestically and internationally to promote information exchange globally and to establish a sound foundation for safety.
- (3) To broaden the scope of the battery system to be commercialized and to advance related R&D activities efficiently, technical studies will be advanced on a stationary type, a mobility type and a hybrid type enabling the mutual utilization of the functions of these

basic types.

- (4) A setup will be established to solicit the cooperation of enterprises belonging to various fields to promote the establishment of related technologies under consignment.
- (5) The feasibility of commercialization of various themes will be assessed through interim studies linked to actual commercialization.
- (6) Development will be advanced while surveying the results of R&D by supported domestic and foreign-based organizations as well as the results of other domestic and foreign private organizations.
- (7) In the ultimate evaluation, both the battery performance and other matters will be studied such as economy.



360Wh Lithium-ion-battery

**Table 1. Development Targets**

1. The functional targets of the high-performance futuristic lithium secondary battery to be developed through this distributed type battery power storage technology R&D project are as shown below:

Type	Stationary Type	Mobile Type
Battery	2-kWh Class Module	3-kWh Class Module
Unit weight energy density (Wh/kg)	120	150
Unit volume energy density (Wh/volume)	240	300
Output density (W/kg)	-	400
Life cycle (cycle)	3,500	1,000
Energy conversion efficiency (%)	90	85
Others	(1) Development and application of battery control and protection mechanisms to secure battery safety and recyclability. (2) Consideration of the natural environment when designing battery safety and recyclability.	(1) Development and application of battery control and protection mechanisms to secure battery safety and recyclability. (2) Consideration of the natural environment when designing battery safety and recyclability. (3) Achievement of the various charging and discharging characteristics demanded in the applied environment (temperature, vibration, running characteristics, etc.) of electric vehicles.

2. The economic attributes to be taken into account in the process of developing distributed type battery power storage technology are the following:

Stationary Type	Mobile Type
The mass production of batteries should allow the cost of the battery to compare favorably with the cost of installing a household battery power storage system of 20 kWh class, taking into account the daytime and nighttime differences in electric charges.	When engaging in the mass production of batteries, the late nighttime electric charge of an electric vehicle mounting a 45-kWh class battery system and running for its full life expectancy should compare favorably with the fuel cost of a gasoline automobile running over the same distance.

# GENERIC TECHNOLOGY REVIEW

## Marine Geological Research in Tokai Offshore Region

*This section describes various basic research and development activities in Japan to inform the world about generic R&D efforts here.*

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### Marine Geological Research in Tokai Offshore Region

#### *Geological Survey of Japan*

The Tokai offshore region is believed to be the hypocentral region of the large Tokai earthquake that is expected to occur in the near future. Up till now, several models of earthquake faults have been suggested. However, the mechanism of a submarine earthquake has not been elucidated, as adequate scientific data around earthquake faults is not available. This Tokai offshore region is also vital for long-term variations in the behavior of the Kuroshio (a major warm current) in concert with global warming as well as the mechanism of material cycles in off-shore areas around the Japanese Islands.

The Geological Survey of Japan of the Agency of Industrial Science & Technology has continued to collect and substantiate marine geological information relating to Japan's offshore regions in order to make use of them for the national land preservation, utilization of marine space and exploration of submarine resources. The surveys in the coastal regions around Honshu, Shikoku and Kyushu has been already completed. A similar survey has been conducted in the areas western off Hokkaido since FY 1994. The Tokai offshore region was not covered with these previous surveys. This is the area in which the Tokai earthquake is expected to occur, and is close to the hypocentral region of the Tonankai earthquake. Hence, collection and substantiation of marine geological information especially on active seabed faults in this region is urgently needed.

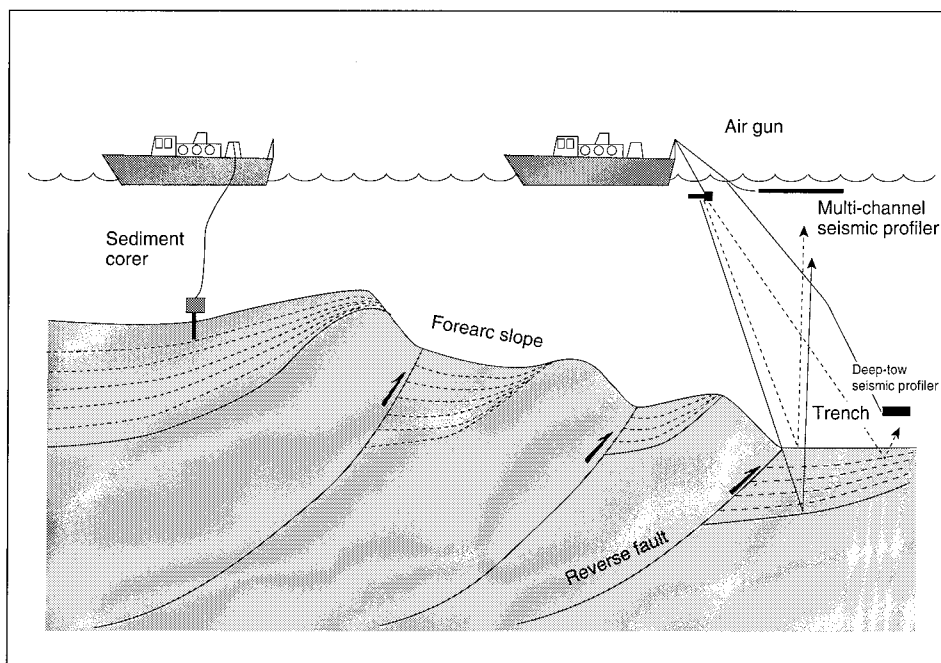
The objectives of marine geological research in the Enshu-nada and the Suruga Bay regions may be summarized as follows:

- (1) Clarification of the submarine geological structure and preparation of the marine geological map.
- (2) Clarification of the distribution of bottom sediments and preparation of the sedimentological map.
- (3) Clarification of the seismotectonics of the region.
- (4) Clarification of the mechanism of material cycles and paleo-environmental changes in the region.

The geological survey vessel Hakurei-Maru is to engage in geological research cruise to investigate the geological structure by conducting single- and multi-channel seismic surveys, and to collect bottom sediments by the use of a gravity corer or a grab to clarify the distribution of them.

Those data and samples are subjected to subsequent analyses and research in order to accomplish the objectives.

Through this research program, geological structure and bottom sediments distribution in the Tokai offshore region will be clarified, and basic information will be accumulated, which are useful for clarification of seismotectonics, exploration of natural resources etc. In particular, great expectations are being placed on more accurate prediction of the position and scale of the Tokai earthquake, and on more reliable estimation of earthquake hazard. It may also become possible to forecast the cycles of generation of earthquakes from the distribution of bottom sediments. Meanwhile, clarifying the variation of the Kuroshio in concert with paleo-environment is anticipated to provide basic data for the estimation of marine environmental changes in the future.



*Marine geological survey of arc-trench area*

97-09-100-01

### Asymmetric Chemical Microscope for Superhigh-Sensitivity Discrimination of Optical Isomer Structures

Prof. Kenso Soai and Dr. Takanori Shibata of the Faculty of Science, Science University of Tokyo, have established a technology to discriminate the structures of optical isomers at a superhigh accuracy and ten times better sensitivity than by conventional methods.

A catalyst is used to discriminate which of the d- and l-isomers of a specific structure is present in larger numbers in a mixture. Since this system features a function to amplify the optical purity, it is called the asymmetric chemical microscope.

With this new technology, an asymmetric autocatalyst is used that specifically synthesizes only the isomer with either the d- or l-structure. Firstly, the mixture of both d- and l-isomers is converted into a complex consisting of metals and organic substances. The complex is reacted with an asymmetric autocatalyst called pyrimidyl alkanol. Pyrimidyl alkanol amplifies only the d-isomer only if the complex is of the d-type, and amplifies only the l-type only if the complex is of the l-type.

As a result, a very small sample of compound can be evaluated very accurately and with ease. In experiments, tests were advanced with optical isomers containing hydroxyl (OH) groups, which corrobo-

rated that even slight differences on the level of 0.05% can be discriminated. The high performance liquid chromatographic system and the nuclear magnetic resonance (NMR) system have been used previously to discriminate optical isomers by assessing substance affinity, but the accuracy had been limited to the level of 0.5%.

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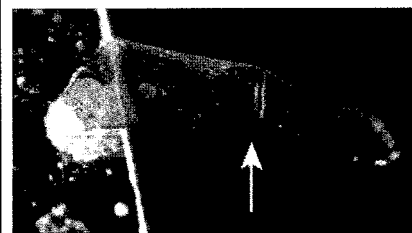
### Laser-Induced Athermal Deformation of Chalcogenide Glasses

Prof. K. Tanaka and his research team at Faculty of Engineering, Hokkaido University, has demonstrated that chalcogenide glasses under weak laser irradiation become soft allowing athermal deformation under small load, or expansion if there is no load.

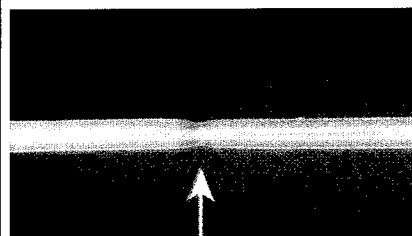
Chalcogenide glasses are a family of glasses containing a large amount of the chalcogen elements (sulfur, selenium and tellurium). They are transparent to infrared light, and are used in optical systems such as copying machines. The new effects may be developed into a microfabrication technology for making chalcogenide glasses into desired microscopic shapes such as lenses a few  $\mu\text{m}$  across.

In experiments, a 10-mW 633-nm HeNe laser beam was focused on a 0.1-mm-diameter area of a fiber made of a chalcogenide glass under about 10-g tensile load. After 2-hour irradiation, the fiber had formed a waist at the irradiated spot. This

Optically processed  $\text{As}_2\text{S}_3$ .



(A) An  $\text{As}_2\text{S}_3$  flake was subjected to bending stress and illuminated through a side surface (indicated by the arrow) with a focused beam emitted from a 10-mW He-Ne laser for 2 hours.



(B) An  $\text{As}_2\text{S}_3$  optical fiber was illuminated with the He-Ne laser light for 5 hours under elongating stress.

implies that laser irradiation can soften chalcogenide glasses no matter how low the power is. Even a weak laser beam of 2 mW could soften the glass fiber if the irradiation time is long enough.

The softening process is definitely athermal. The research team ascertained that the photoinduced fluidity is caused by a photoelectronic process. Photo-conduction tests proved that photon bombardment can excite electrons and holes in chalcogenide glasses. When the excited carriers recombine, atomic bonds may change to relax little by little stresses in the glass. However, what really happens at the irradiated spot remains unknown.

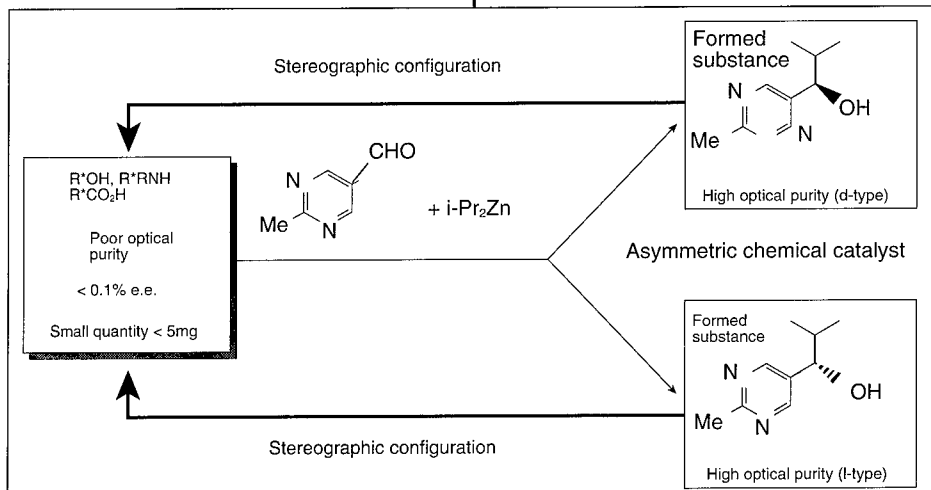
The research team also found that when a plate of chalcogenide glass is irradiated by a subbandgap laser beam (say, 10  $\mu\text{m}$  in diameter) with no load imposed on the plate, the irradiated spot expands and the face protrudes by a few micrometers. This giant photo-expansion can be used to build an array of microlenses.

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Principle of asymmetric chemical microscope

# **Special Features**

## **Futuristic Image of Consumer Electronic Equipment in the Age of Digitalization —Present Set Top Boxes and Future Outlook—**

*Takuyo Kogure*

*Vice Chairman of STB Research Committee  
Electronic Industries Association of Japan*

### **1. Introduction**

Recently, the set top box (STB) has frequently been the topic of discussion. This is probably because the general image of futuristic information processing terminal equipment overlaps with that of the STB.

More recently, the term “multimedia” has been replaced rapidly by the term “Internet,” and all dialogue is advanced with “Internet Protocol (IP)” as the key word. However, the characteristics of Internet, or the network of best effort type, tends to suffer uncertainty in connection reliability (the long time required and the need for confirmation of linkage), so there may be a sense of opacity in the future image of IP type STBs. Some consider the trend shown is, “the quality improvement of TV images is the very essence of next-generation entertainment,” and that there is a need for STBs to conform to this need.

With these expectations, STB has been expanding its variety of performances and functions. Therefore, discussing the overall image and the future of next STBs is a matter for pure speculation. However, the author is a member of the STB research committee and participates in the association’s survey activities, so this report offers a summary of the results of these activities.

This report is intended to serve as reference material for those reading this article, and discusses the issues for STBs today and offers an outlook on the consumer equipment known as STBs.

### **2. Set Top Box Product Groups and Their Trends**

#### **(1) CATV System Terminal Equipment**

Digitalization of the CATV system was indispensable for TV viewers for their demand had been image quality improvement and more channels. The cable enterprises which are presently retaining their business by analog transmission are certain to shift to digital transmission sooner and at a comparatively early stage. As the CATV transmission mode, technologies relating to the hybrid fiber coax (HFC) are under development, especially in the sector of optical fiber communications. In the United States where the CATV system is advanced, the present node is observed to extend to 500 households, and further by the year 2000, a node is anticipated to link 200 households. The Fiber to the Home (FTTH) network is also coming into wide use, and the large-scale Video on Demand (VOD) system based on the standards of the Digital Audio Visual Council (DAVIC) system is under commercialization.

The attempt to engage in data communications by applying the CATV interactive communications function and utilizing the idle analog CATV channels is being commercialized as Cable MODEM since a transmission rate of about 10 Mbps can be secured, and linkage with the Internet system is already under study. The Cable MODEM is available in the symmetric type in which the uplink and downlink transmission rates are the same, and the asymmetrical type in which the uplink and downlink transmission rates differ. Cable MODEM is normally connected to personal computers (PCs), but compound products are appearing, such as the TV type PC and PC type TV, so these terminals may also be regarded as a sort of STB equipment. The move to establish Cable MODEM standardization is presently chaotic, but there is no notable difference in the functions and

*JETRO, September 1997*

interfaces of the products commercialized by various companies, so coordination of standardization may occur in the comparatively near future through organizations such as DAVIC and IEEE.

Some critics assert that the future of the CATV system is precarious, but the development of related technologies supporting this business is proceeding steadily. A good example concerns the high-efficiency image transmission technique Cherry Picker of IMEDIA Corp. that enables the number of programs to be increased substantially with the same bandwidth. Statistical multiplexing technology is employed to enable image transmission of up to 24 channels with one analog channel of 6 MHz bandwidth. This channel bit allocation technology dynamically monitors the peak information volume of several channels that relies on the input image volume, and sets the basic bit rate at about 1.5 Mbps for each channel (source: IMEDIA Corp. pamphlet *Spurring Digital Television*).

In my opinion the company's demonstration of a system presently under development indicates that the system is similar to an ordinary TV screen, as long as the viewer is not concerned so much about the slight inferiority in image quality. Actually, each channel is contained within about 1.5 Mbps/ch, so when allocating fast-moving sports programs to several channels, overflow of bits (bits surpassing the accommodation capacity) may occur, so complicated bit allocation processing by the computer may be demanded. Based on observation of the demonstration images, there is still ample room for concrete improvements as in connection with the peak bit processing technology.

Several CATV market experiment results are linked not only to increasing the number of channels but also to substantiating new interactive communications services such as TV shopping, remote schooling and remote offices. As a typical example, there is a coordinated system using 750 Mhz HFC, through which AMERICAST (in Atlanta region, U.S.) is starting to offer various kinds of services. On the other hand, there are deep-rooted observations that Orlando's VOD market experiment is not linked to business, so the future of the CATV business hinges on creating and commercializing, at an early stage, a scenario that can favorably compete with the digital satellite broadcasting system that has gained ground recently as well as with the Microwave Multipoint Distribution Service (MMDS) and the Local Multipoint Distribution System (LMDS).

## (2) Wireless Information Terminal Equipment

MMDS and LMDS are the typical systems for offering wireless data services. MMDS is a system that uses radio frequencies of up to 10 GHz and which is used for getting direct access to STUs connected to receivers lying within a radius of about 50 km. More recently, interactive type systems have been under study, and DAVIC is scrutinizing the feasibility of mapping with ATM signals (DAVIC1.3 Spec., Part 08).

The LMDS system which has drawn attention recently is a interactive radio system using microwaves of over 10 GHz and having a service area lying within a radius of several kilometers. There is an example of an experiment to carry 49 channels of TV broadcasts, and a plan to start telephone services by capitalizing on the interactive characteristic. As with the MMDS system, downlink signals are structured with ATM cells or MPEG2TS, and the ATM cell for uplink signals. Upon commercialization, the system may be recognized for use in local audio telephone services.

The FCC will permit allocation of frequencies to LMDS before long (Nikkei Newspaper dated March 6), and if joint telephone services are started together with the Internet Service, this system may be a formidable competitor for CATV enterprises.

## (3) Satellite Broadcasting Receiving Terminal Equipment

American digital satellite broadcasting systems (DBSs), with DirecTV assuming the leadership, have accumulated comparatively rich practical experience and are established in the market. The market price of STBs, or terminal equipment, are not at the low prices of \$400-500/set as initially surmised by some observers. The reasons for the non-availability of terminal equipment at low prices were the high costs of MPEG2 decoder LSIs, and because of the existing disparity of the encoding systems of broadcasters, so high-volume production of STBs of the same specifications is not possible.

STB terminal equipment is an additional cost for general household viewers, excluding PC users unconcerned about the cost burden, so will have to compete fiercely with CATV terminal equipment in the aspects of both price and functions, so many issues remain to be resolved to maintain market viability. However, diverse broadcasting modes are available which capitalize on the advantages of the DBS and the distinct advantages, such as the capability of offering quality image broadcasting com-

## Futuristic Image of Consumer Electronic Equipment in the Age of Digitalization

parable to high-definition (HD) broadcasting as well as the ease of offering global services in the same manner as the Asian SAT system, and the development of compatible STBs is proceeding. Regarding the multichannel service that is a sales point, there is a limit to the number of TV programs prepared in conformance with DBS specifications, so relying on the retransmission of CATV programs appears feasible to increase the number of programs. However, a part of the American satellite broadcasting enterprises are not retransmitting CATV programs, possibly since contracts with CATV enterprises are not proceeding smoothly. The reason has not been confirmed, but the number of actually broadcast programs appears rather less than that initially expected.

In Japan, full-scale digital satellite broadcasting started in the latter half of 1996, and today many households are subscribers. Available on the market as compatible STB terminal equipment are the special-purpose equipment of the respective broadcasting stations, so viewers desiring to receive programs from several stations will have to procure the same number of special-purpose terminal equipment which increases the financial burdens. A topic is the utilization of the BS4b in digital format (Ministry of Posts and Telecommunications inquiry reply of May 30) that is observed to suggest the future direction of development of STBs in Japan. Therefore, there are observations that this will trigger widespread use of digital STBs.

In Europe, Digital Video Broadcasting (DVB) has already been commercialized, and widespread use of STBs on a full-scale is about to start, but the system does not use the simple type of receiving equipment but rather Philips' Clever Cast broadcasting type VOD/NVOD system that responds to user preferences via a public network system (source: Philips Clever Cast pamphlet). The software composition of STBs using the Clever Cast System as well as the interface conform to DAVIC specifications, and Philips is engaged in active public relations activities in connection with its "Enhanced Broadcast" profile with the aim of having DAVIC to recognize the system as compatible with international standards.

### (4) Ground Wave Digital Broadcasting Terminal Equipment

The ground wave digital broadcasting is just about to start in the United States. However, the NAB observation is that the mainstay advanced television (ATV) standardizations have not been fully endorsed at the present stage. However, the basic standardizations

have already been determined, and the manner of how to use the bandwidth of 19 Mbps secured for the digitalization of one analog channel is left to the decision of broadcasting enterprises.

In particular, the freedom in the selection of broadcasting modes through the liberal selection of scanning format is welcomed as a manifestation of the principle of free competition. However, regarding the concept of actually designing sets, opinions vary widely in the TV industry and, as a result, the moves of STB and TV sets are obscured. One approach in the selection is to cope flexibly with high-definition display and multiscanning format, but compared with the analog broadcasting set that simplifies functions, these sets tend to become more expensive. The limiting price level for the wide use of TV terminal equipment will be determined by consumer preferences on the market. As a means to suppress the price, the format conversion adapter mode is conceivable as an interim product similar to STB, but this may be assimilated into the STB or TV set.

Regarding the digitalization of ground wave broadcasting, the Ministry of Posts and Telecommunications has announced a study extending up to the year 2000. This issue has been taken up by the mass media frequently in the past and its feasibility has been demonstrated technically, but no outlook for actual broadcasting in this mode has been acquired due to several related conditions. The details regarding broadcasting systems will most likely be taken up by some "ground wave digital broadcasting study committee" to be held in the future.

### (5) Flow of Quality Imaging

There is a strong preference for high-definition TV in Japan, but interest in the United States is also increasing in this connection. The WHDTV Station in the northern part of Washington DC is an experimental-stage broadcasting station situated in NBC's Washington Station, but possesses a complete array of sophisticated experimental facilities including a high-definition (HD) transmitter and HD transmission antenna. An officer of the station announced that the antenna has an output of 15 kW (peak 60 kW), and that it is oriented toward Washington city and covers the entire federal administrative building region.

Due to the location in Washington DC, many governmental officials visit the station, and photographs of visitors are shown in the hallway, which indicates the deep interest of the government. The interest is high among enterprises in connection with STB and special-purpose imaging equipment conforming to

HDTV broadcasting, but since radio waves are not being transmitted at present, the station has no presence in the market as yet. Nevertheless, some enterprises, the AMPRO Corp., for example, have fabricated and installed a 62-in projection type large display system in the station and are studying the display system practicality.

## (6) Internet Terminal Equipment

The introduction of Web TV indicates the flow in the appearance of new products. The availability of this product on the market at present is as yet limited, and whether this product will become deep-rooted on the market will depend on consumer preferences, but some time may be required to develop the image of the product. The concept of Internet TV is strictly to get access to Internet with ease via the TV set and to display the home page and other desirable programs rapidly without cumbersome keyboard typing, and therefore does not have the full-scale functions comparable to those of the personal computer. For example, upgrade of version and memory expansion, standard functions of information processing terminal equipment, are not possible.

Recently, a federation of enterprises announced the Network Computer (NC), an attempt to alleviate terminal equipment burden on the premise of software downloading and to bolster special-purpose network operating functions. As a special-purpose NC chip, SUN Microsystems Corp. announced its chip set concept involving the commonly known JAVA Chip and is striving to create a full-scale market. This chip will facilitate the descriptive language and the formation of special-purpose architectures, and may become a de-facto standard, so its acceptance on the market is attracting attention.

Another example of the NC-like concept is audio/video coding on the premise of downloading and its systematization, which represents the Moving Picture Expert Group (MPEG-4) system of the International Standard Organization (ISO). This object oriented coding system is slightly different from conventional standardized systems and designed to substantiate individual functions by assembling standard tools. Each application is defined as a necessary "Profile" function and several levels are provided in the profile. For example, the Broadcast Profile places emphasis on the flexibility of use of the broadcasting type service, while the "Low Delay Profile" takes into account the mobile videophone and places the major emphasis on the delay time and terminal hardware. These "Profiles" define matters such as mutual operability and the interchangeability between the respective sets.

The MPEG-4 system enables multiple users to enjoy a game via the Internet, also defines the method of synchronizing synthesized images and synthesized sound sources with natural images and audio signals. Therefore, MPEG-4 provides STB systems and functions which are a step ahead of their conventional counterparts, or provides new standard systems such as ISO/WG11, N1610 and MPEG97.

Intel Corp. has an MPU module concept of supplying, in a complete set, the diverse chips mounted on the mother board that comprises an STB. Using this new MPU module enables notebook type personal computer architecture, for example, to be structured with ease, enabling the fabrication of advanced high-performance STBs and PCs with ease.

## 3. Feasibility of Merging of TV Set and Computer Functions

The real examples of the STBs described up till now are indicated in simple structures in the figures. Fig. 1 shows the structural blocks of these STBs, Fig. 2 the software constructions, and Fig. 3 the VOD service models of the system reference models prescribed by the DAVIC.

These STBs are literally mounted on TV sets. In general, a TV set is used in the living room that is a place for pleasure and relaxation. Now, even if the TV type PC combining PC and TV was installed in the living room, sitting on the sofa and typing the keyboard may not be so pleasant. Also, inconveniences may be encountered when engaging in PC input with a remote controller. The size of the characters on the display as well as the physical distance between the viewer and the display unit may also be vital when judging the conveniences of these STBs.

It may be too early to arrive at a conclusion, but at any rate, a considerable gap appears likely with a living space in which the TV set is placed at the center or a living space in which the user is facing the PC monitor. It appears that an analysis of this life style, working convenience or sense of living, will be helpful for arriving at future judgements.



## Futuristic Image of Consumer Electronic Equipment in the Age of Digitalization

**Fig.1. Example of STB Structural Block Construction**

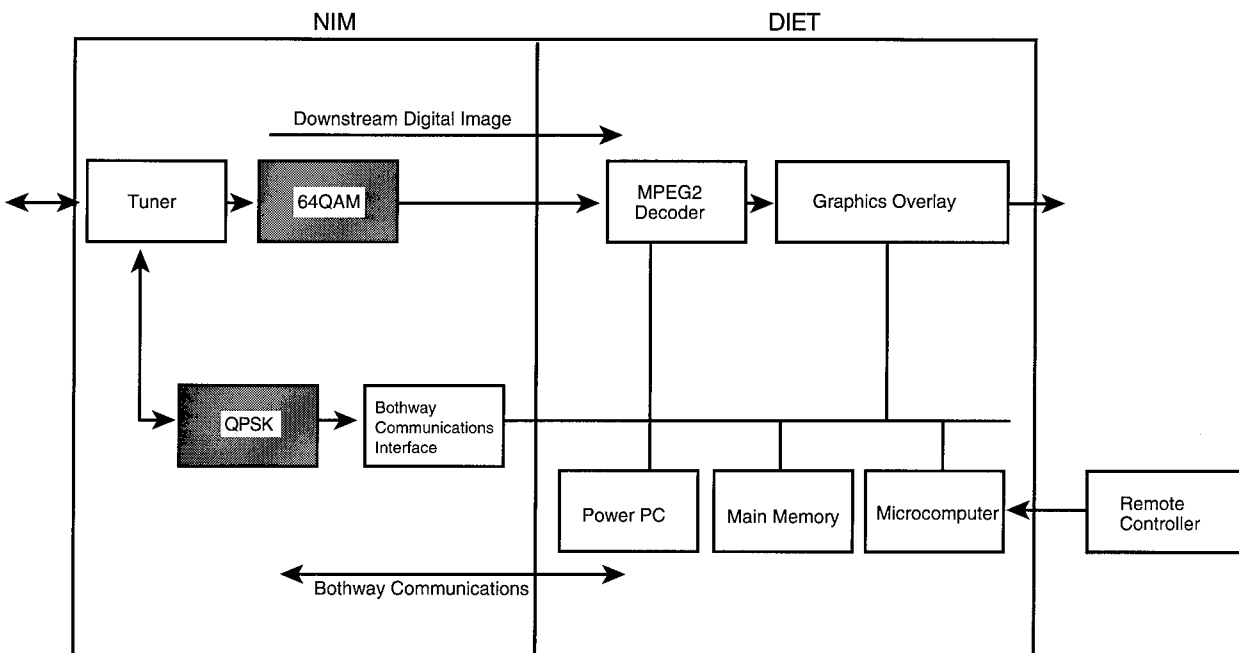
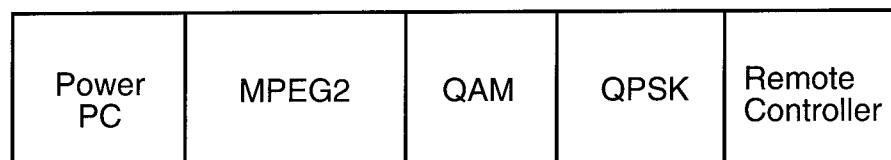
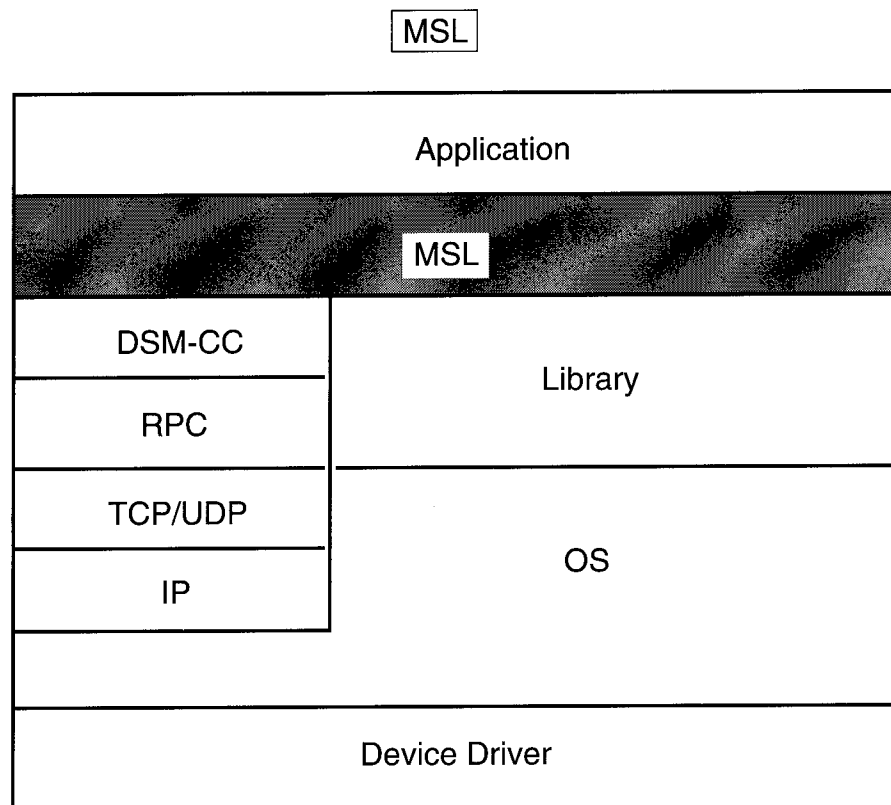
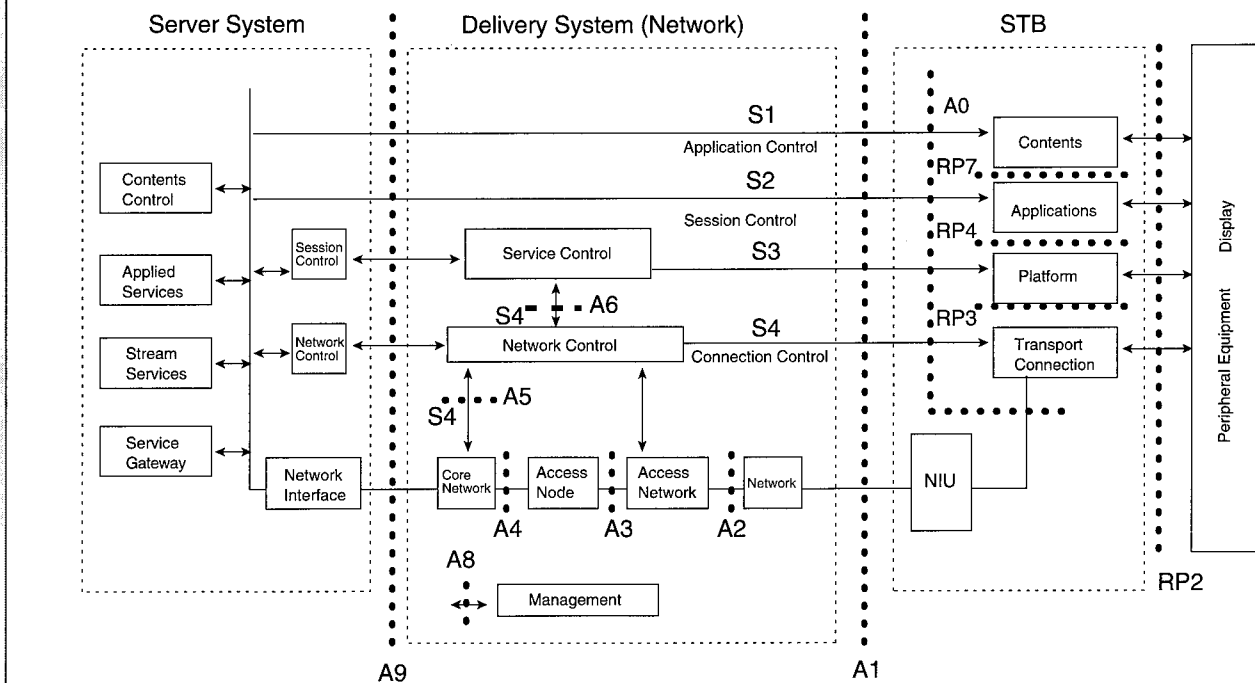


Fig.2. Example of STB Software Construction



## Futuristic Image of Consumer Electronic Equipment in the Age of Digitalization

**Fig.3. DAVIC 1.0 System Reference**



## 4. Search for a Futuristic STB

The futuristic images of STBs have been studied from diverse perspectives, and this article is concluded by listing the items which are the most vital in our search for a futuristic STB image.

- (1) Will the competition and progress of media such as the cable broadcasting, satellite broadcasting and radio systems be advanced through cooperative progress or through the selective process?
- (2) What are the end results to be brought about by the digitalization of broadcasting that is presently in progress?
- (3) What are the influences to be exerted by the emergence of a network society and the downloading function?
- (4) What are the progress and limits of the best-effort type Internet Protocol (IP) network?
- (5) What are the influences and changes brought about by a network-oriented society on our lives?

The author would like to consider these matters in the process of STB progress. The author hopes that this article will be valuable as a reference material for readers.

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# Digital Archives in Japan

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## 1. Digital Archives Concept

The cultural assets of humanity which were created and accumulated throughout the ages are infinitely valuable treasures common to everyone and, at the same time, are the foundation to establish the identities of various countries as well as the means of mutual understanding. Cultural assets are destined to undergo gradual deterioration with time, and some are on the verge of human destruction, so society is actually confronted with diverse issues which obstruct the preservation and public exhibition of these cultural assets.

Japan's Digital Archives Concept, by applying high-definition digital imaging and advanced multimedia technologies to resolving these diverse common issues of humanity, aims to:

- 1) Record and store these cultural assets in the form of digital images featuring excellent recording accuracy and color reproductivity, and
- 2) Establish a sophisticated system structured on a data base and network that would permit these stored cultural assets to be retrieved and appreciated anytime, anywhere and by anyone.

While Japan's valuable cultural assets are located not only within the country but also overseas, many of which require restoration, so assistance has been offered, and the Digital Archives Concept also aims to apply these technologies to record restoration of these cultural assets and to preserve related crafts. To enable these activities to be advanced efficiently on a national scale, also through international cooperation, the Japan Digital Archives Association (JDAA) was established in April 1997, and efforts are being made for the realization of the concept with the cooperation of the industrial, governmental and academical circles as well as local governmental organizations, and under the guidance of the Agency for Cultural Affairs, the Ministry of International Trade and Industry and the Ministry of Home Affairs.

## 2. Present State

Digital archives performances in Japan include those relating to the use of the multimedia technologies to the country's museums and art galleries, regional promotion by applying multimedia technologies, and cultural assets recording uses CD-ROM and other tools.

### (1) Museums and Art Galleries

A High-Vision Museum Concept was started in Japan in 1988 in connection with national museums and art galleries that essentially consists of installing high-vision theaters (high vision = high-definition TV commercialized in Japan with 1,125 scanning lines and effective resolution of 1,920 x 1,035). As of this year (1997), these theaters have been installed at 200 places, and public exhibitions through the Internet have started using related data-base images. These data-bases are participating in a common retrieval network system based on the Cultural Assets Information System Concept proposed by the Agency for Cultural Affairs, and the standardization of cultural assets-related data in the country is expected.

The National Museum of Ethnology is offering exhibitions by fully utilizing multimedia resources. The University Museum of the University of Tokyo has been striving to establish a digital museum from the outset of its establishment, and is conducting various types of experiments in museums and on networks with the aim of publicly exhibiting its collections which run up to as many as 6 million items.

### (2) Regional Promotion

In various regions, utilizing traditional regional culture and industrial arts will be quite effective to establish the local identity and to promote regional culture and industrial progress. However, the preservation and handing down of these assets is becoming increasingly difficult, so the digital archives approach has started.

Ishikawa Prefecture, in particular, is storing information relating to its lacquer ware, porcelain and dyeing arts in a multimedia data base under the Digital Archives of Ishikawa Japan, and is disseminating information through a network and producing CD-ROM disks. Gifu Prefecture is also quite active and is scheduled to invite an Electronic Imaging & Visual Arts (EVA) Conference in April 1998.

### **(3) Packages**

Packages including CD-ROM disks include titles such as Japan's National Treasure Buddhas and World Assets, but related activities are rather slow. However, there is a big stock of high-vision digital image disks, and since the image control and rights business that is advanced in the United States is growing in Japan, this packaging sector is anticipated to grow into a big market in Japan in the not too distant future.

In addition, in Kyoto and other regions, an attempt is being made to record intrinsic national ancient colors and patterns, and to disseminate information globally for use as reference material for design.

## **3. Future Methods of Approach**

The digital archives concept has started to take root in Japan and various related activities are in progress, but diverse problems still remain to be resolved, as in connection with the coordinated implementation of these activities in the country, conformance with international standards and further promotion of widespread public enjoyment of cultural assets.

### **(1) Promotion of Widespread Enjoyment of Cultural Assets**

In Japan, only about 30% of the cultural assets designated by the central government and local autonomous communes are possessed by public museums and art galleries, with the remaining 70% possessed by shrines, temples and individuals. Introducing these 70% of cultural assets to the public by digital imaging is a vital but difficult matter. To resolve this matter, it will be necessary to permeate the sense of significance and recognition of the importance of public enjoyment of cultural assets, strike a balance between the public nature of cultural assets and private rights and gains, and establish a format for handling rights in the process of utilization of cultural assets. Efforts are being made to resolve these related matters by the JDAA.

### **(2) Technical Infrastructure for Effective Utilization of Cultural Assets**

A plan is underway to establish a model technical infrastructure indispensable for promoting the digital archives concept and its effective utilization. The infrastructure defines the flow of all processes from data input to the establishment of a data base, network and display system, and clarifies the standards relating to color reproduction, high-definition display, data base establishment and the functions, characteristics and conformance standards of ancillary systems and equipment. In parallel, studies have been started to establish a next-generation version electronic museum.

### **(3) Fostering of Personnel for Content Production**

For popularizing digital archives and promoting effective utilization it is necessary for digital archives contents to be of high academical level, fascinating and easy to understand by the general public. For this, it will be indispensable to foster personnel for content production. The members of museums and art galleries are offered education in connection with multimedia technology, while educational systems and facilities are being substantiated and opportunities are being established for holding contests.

### **(4) Expansion of Digital Archives Targets**

The targets of the digital archives concept are not only traditional cultural assets but also items which have helped to establish the country's industrial science and technology history as well as other films, photographs and designs which are observed as deserving preservation and public exhibition from the social perspective.

The digital archives concept is being advanced while resolving these diverse issues and with the anticipation of creating new businesses in the process. The realization of this concept appears possible in view of the progress being achieved by the Internet system, the introduction of the age of full-scale digital broadcasting in the country by the year 2000, and the progress achieved in the packaging business in concert with the development of high-performance digital video disks (DVDs).

## Digital Archives in Japan

### 4. Japan's Role in Promoting the World Digital Archives Concept Creation

Japan has hitherto participated in joint international projects for the Realization of Electronic Museums and Galleries and the Promotion of Communications to Establish a Global Network through the agreements reached through the G7 (seven industrially advanced countries) Information Infrastructure Summit Conference held in February 1995. Through these activities, Japan has made international contributions in the sectors of technology and culture.

#### (1) Technological Contribution

Japan has high-definition (HD) display systems and sophisticated color printing technologies represented by high-definition imaging, and the HD display systems, in particular, feature the highest quality level demanded by the digital archives concept, and further sophistication is in progress. Also, a joint domestic project is presently in progress to establish a technology based on advanced display and printing techniques for color regeneration of real objects with high fidelity.

Further, in recent years, the progress and wide use of the digital still camera technology have been conspicuous especially in Japan, and this is anticipated as a low-cost means for data input in the sector of digital archives. In addition, the digital video disk (DVD) has started to be introduced, which is conceived to be the highly effective second-generation version storage medium. Research is also being advanced on technology to regenerate the digital images of cultural assets to the state when they were initially produced, which is also anticipated to contribute to the progress of digital archives. Meanwhile, cooperation is being offered to promote the application of these technologies as well as for the establishment of international standards as in connection with data format.

#### (2) Cultural Contribution

The progress of the digital archives concept is revealing domestic cultural assets to the Japanese public, and together with the Japanese cultural assets in foreign countries, peoples worldwide can acquire an overall knowledge of Japanese culture. Even foreign cultural assets in Japan are being revealed to the public, which is conceived to enable de facto coordination of the cultural assets belonging to various countries. Regarding

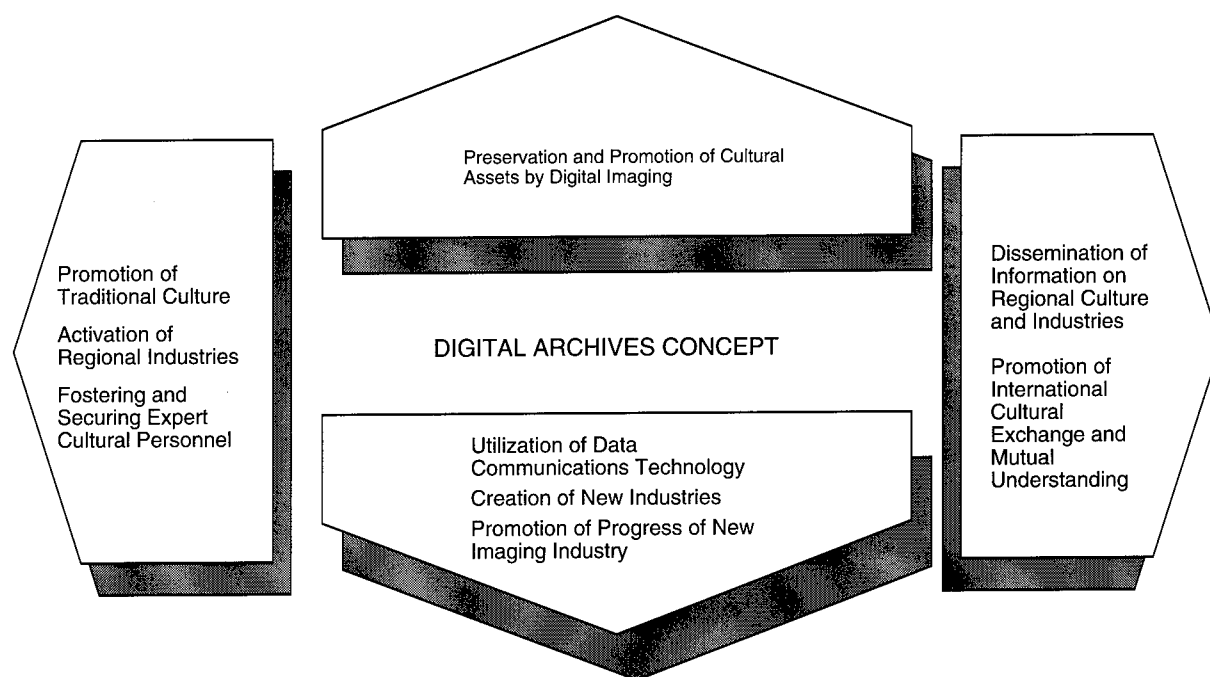
digital archives in other Asian countries, it will be necessary for Japan to offer support for their realization.

### 5. Postscript

Digital archives are highly effective for establishing the cultural identities of countries, and this, in turn, has the effect of encouraging people to recognize the values of respective cultures and to increase mutual understanding of different cultures, eventually eliminating frictions between countries. Even from this aspect, it will be necessary for Japan to promote this digital archives concept as actively as possible.

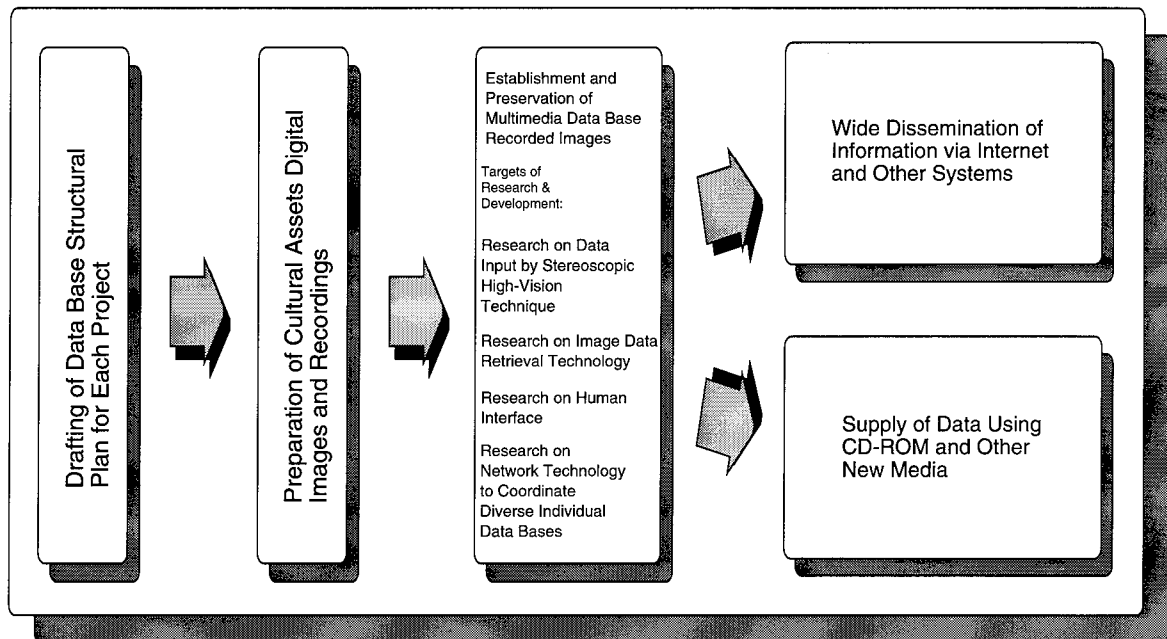


**Fig.1. Digital Archives Concept**



## Digital Archives in Japan

**Fig.2. Steps Involved in the Digital Archives Concept**



# Colour Management in Multimedia and International Standardization

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## 1. Introduction

The colours of objects were previously represented with chemical substance such as colouring materials and ink, but now colours can be represented as electrical signals or as numerical values. As a result, it is now possible to exchange colour information at network speeds both nationally and internationally.

This advance is made possible by the recent development of high-performance and low-price colour information input equipment (digital cameras and scanners) and output equipment (various types of colour displays and colour printers), supported by the wide-area network systems indispensable for data exchange.

This article discusses the necessity and significance of "colour management" and the recent trends in related international standardization. With colour-related equipment, data processing is performed with the purpose of achieving excellent colour reproduction. This operation within equipment is called "colour control" and is differentiated from "colour management" that is the operation of resolving incompatibilities between equipment or network systems.

## 2. Background of Colour Management

### (1) Outline

The problems relating to colour reproduction have long been recognized in the field of ordinary offset printing, the field of colour calibration that demands superelaborate operations, and the field of colour photography, and these colour reproduction problems have been resolved independently by these fields. In the process, international standardization in these industrial sectors has been achieved by the Technical Committees (TCs) or the Subcommittees (SCs) of the International Organization for Standardization

(ISO), based on the international standards or technical articles recommended by the Commission Internationale de l'Eclairage (CIE).

In the field of electrical and electronics engineering, colour television was first developed and commercialized through the establishment of sophisticated electronic circuits and optoelectronics conversion technology due to the emergence of the cathode ray tube (CRT), but colour reproduction was limited to the sector of broadcasting, and standardization was achieved sporadically by individual regions. Next, the development of compact electronic components and compact high-performance electronic computers, and the successive introduction of these technologies into colour reproduction equipment, triggered the electronification of colour reproduction systems and equipment in the individual fields. Typical examples of electronification are the introduction of the digital camera, colour printer, colour scanner, and various coloured picture and coloured image display equipment (CRT, liquid crystal display panel, plasma display panel, light-emitting diode array, etc.).

Colour information is continuous, and the equipment handling such information originally used analog signals, or electric signals consisting of voltages and currents. Signals were processed to achieve better colour reproduction, but this required conversion of the analog colour information into digital information, and colour information was utilized after performing the necessary processing with a general-purpose or special-purpose digital processor (such as microprocessor) built into the equipment. The normal procedure had been to reconvert these signals into the analog mode, but with this cumbersome method of approach, colour reproduction was problematical in the electrical and electronic industries. Therefore, the International Electrotechnical Commission (IEC) promoted international standardization in television receivers, colour video cameras and colour printers.

## Colour Management in Multimedia and International Standardization

However, if the ISO, IEC and the International Telecommunications Union (ITU) that is a subsidiary of the United Nations (UN) were to engage independently in colour reproduction standardization in their respective domains of influence, then duplication and defects are likely, so a Joint Technological Advisory Group (JTAG 2) was established as an adjustment group in connection with the "imaging technology."

### (2) Necessity and Significance

Due to the conspicuous recent progress that has been achieved in compact high-performance computers and in the digital networks which connect these computers together globally, colour information is exchanged and reproduced in the form of digital information on a global scale through open networks. This system comprises a facet of the so-called multimedia system, and the vital importance of performing global exchange and reproduction of colour information properly had been pointed out from an early stage.

Against this backdrop, in autumn 1995, a new technical committee (IEC/TC 100: Audio, Video and Multimedia Systems and Equipment) was established in IEC. As its first full-scale standardization task, the theme "colour management" relating to multimedia systems and equipment, proposed by Japan, was taken up. The basic concept of the colour management proposed by the Japanese IEC Committee was published as Technical Trend Assessment by IEC in May 1997.

## 3. Background of Colour Management

### (1) Problems Involved in Colour Reproduction

As described earlier, many of the problems relating to offset printing and colour photography are conceived to have been resolved by specific groups of enterprises. Also, customers are hardly concerned about the colour reproduction difference of the colour TV sets lined on the shelves of supermarkets and other retail outlets. However, colour reproduction may not be necessarily coordinated between the colour scanners, colour printers, colour display units and colour projectors which consumers in general procure readily for use with their personal computers (PCs), due to the differences in the types of products, the manufacturer or the time of production. Many readers must have had the experience of finding that when the colour graphics displayed on a personal

computer were recorded as hard copy with a colour printer, the reproduced colours were quite different.

Within a limited range, or in a closed system in which colour information production and reproduction are accomplished by the same person, there is a possibility of colour calibration, or if there was a difference, the colour information may be used with the understanding of the difference. However, if colour reproduction was performed in a remote place with colour facsimile equipment, and involved an open system extending over a broad area that makes the sender's colour reproduction confirmation impossible, it can readily be understood that colour management will become a highly vital operation. Namely, whatever the system or equipment employed for communications, the colour reproduction error will be demanded to fall within a tolerable range.

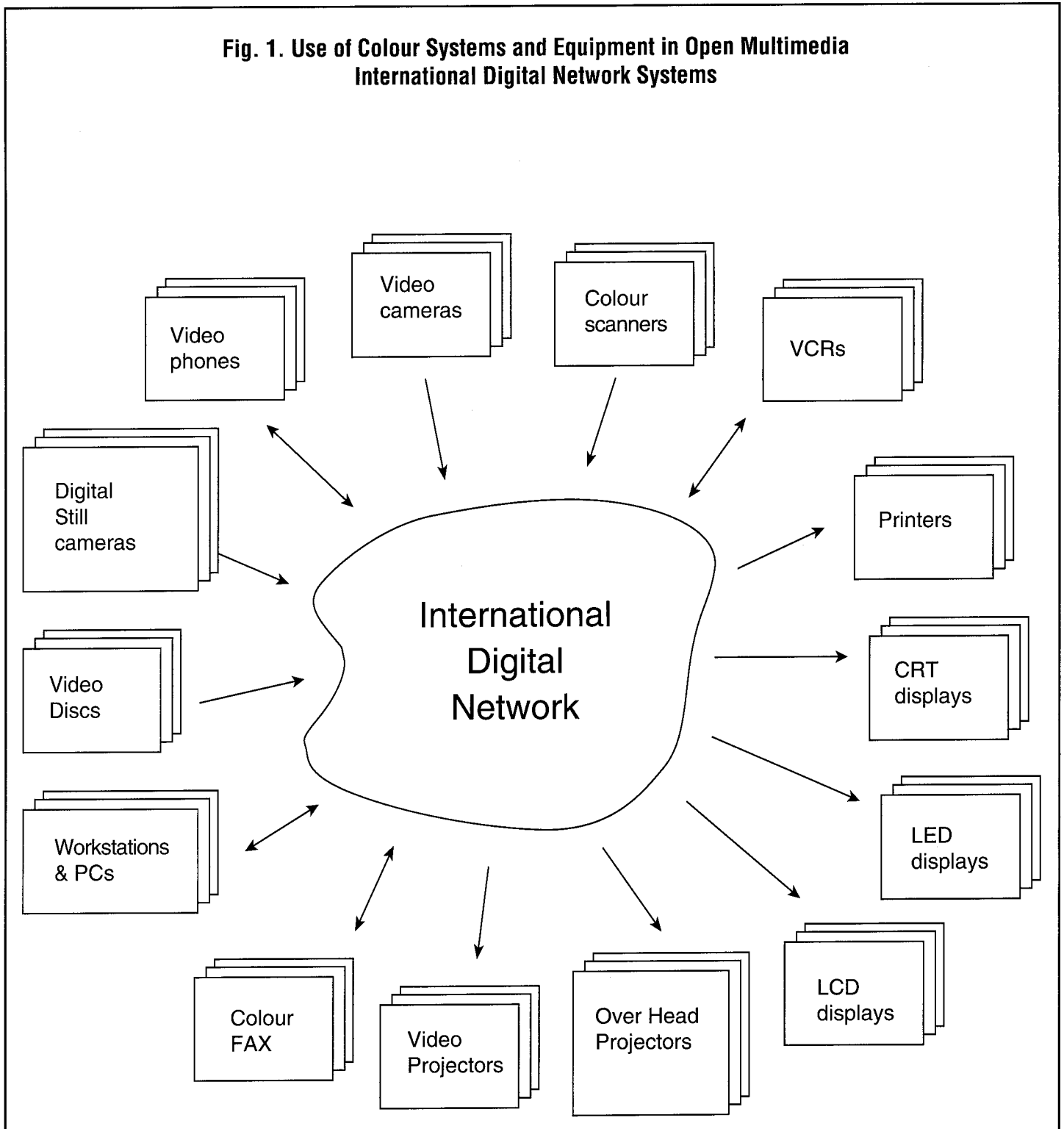
Where colour facsimile is involved, colour information is exchanged simply between the facsimile systems. However, when colour information is exchanged as digital information, and the information shown on a display panel, printed out with a colour printer, or the digital information stored for future reuse, the matter becomes more critical. To cope with this situation, colour systems and equipment are now being used widely internationally in open multimedia international digital network systems as shown in Fig. 1.

### (2) Present State of Global Colour Information Exchange

The general-purpose digital network, or the Internet on a world-wide scale, is being used increasingly by the general public and business enterprises at a rapid pace. This is because whereas there had been only limited modes of utilization by a limited number of persons for the exchange of electronic mail and files transfer till now, the World Wide Web (WWW) communications featuring ease of use and on a global scale was proposed in 1991, and all means of information representation are being incorporated in the system. Namely, WWW is fast becoming a multimedia platform. The aim of WWW is becoming the exchange of coloured still images and coloured moving images, and this can be achieved simply by selecting the links and anchors from the personal computer. Also, individuals can produce the same type of images and transmit colour information to WWW.

Meanwhile, the Internet application to multi-casting is being promoted actively for holding remote multilateral video conferences. This system permits the proceedings of academic lecture meetings, for example, to be televised in various parts of the

**Fig. 1. Use of Colour Systems and Equipment in Open Multimedia International Digital Network Systems**



## Colour Management in Multimedia and International Standardization

world, and enables holding of question-and-answer meetings between viewers situated in diverse parts of the world. With these operations as a wonderful opportunity, efforts are being made to expand the functions of the Internet and to permit TV broadcasting services originally offered to regions where only radio waves broadcasting had been possible. In addition, due to the commercialization of the so-called TV-phone function, it is now possible to engage in televisual international communications.

Observing these applications from the aspect of colour reproduction, colour reproduction is directly involved in diverse sectors, as in the software for producing coloured pictures, the monitors for confirming these colours, the colour scanners and digital still cameras for digitalizing images, the colour information generators such as digital video cameras which actually photograph diverse phenomena and digitalize these images in real time, and the numerous indefinite colour information receiver employed in remote areas, such as the liquid crystal display panels of notebook type personal computers and the CRT display panels of desktop personal computers. At present, colour management is not being performed in these sectors, so the quality of the colour information of both the sender and the receiver is not guaranteed. This is a vital matter that cannot be neglected especially in commercial transactions and in the remote transmission of academic materials in which colour reproduction is important.

Recently, a real-time network video of a lecture multicast over the Internet System was captured and loaded on the World Wide Web site (<http://w3.hike.te.chiba-u.ac.jp/IEC/100/PT1/misc/render.html>) for use as reference for comparing the images televised simultaneously with two different programs with the same type of personal computer (MS-Windows 95) with the images photographed simultaneously with an ordinary camera (not compound photograph). The images were displayed simultaneously on the same types of CRT display panels, but the degree of colour regeneration differed. This is because each televising software performs image processing in its unique method, so simply controlling the colouring characteristics of the personal computer is inadequate. Therefore, all stages of operation of the personal computer, including its software, must be considered. It is easy to imagine that there will be a substantial difference in the degrees of colour reproduction if the images were printed out with several different colour printers.

To cope with the situations described above, it will be necessary at least to establish international standardization of the two following items, and for the colour systems and equipment trade

to incorporate these standards into multimedia systems in order to ship out products featuring excellent colour reproduction performance into the market. These two items are 1) standardization of the framework of colour information exchange, and 2) clarification of the colorimetric characterization of colour-related systems and equipment and supply of specification data.

### 4. Standardization of Colour Information Exchange Framework

To achieve correct exchange of colour information electronically, it will be necessary to supply the following specific data as the attributes of colour information:

- 1) The colour description space involved.
- 2) The quantizing method (number of bits, linear/nonlinear, etc.)
- 3) Order of data arrangement.

The International Colour Consortium, ICC is trying to determine the frameworks of colour information exchange methods, including these data, and to standardize generic frameworks for each type of colouring system and equipment. The contents are being publicized through the Internet (<ftp://sgigate.sgi.com/pub/icc/ICC32.ps>).

ICC is comprised of 36 manufacturers of colouring information systems, equipment and software and, therefore, the proposed colour information exchange framework in multimedia systems is being accepted. However, regarding the Internet that is a typical global open network, there is what may be regarded as an indefinite number of colour information and telecasters, which are sending and receiving colour reproduction by an indefinite number of users. Against this backdrop, a part of members of ICC is coming to recognize the improbability of all colour information telecasters abiding by its regulations. Also, full-scale colour information telecasters are also hesitant about providing headers for colour space information and nonlinear type information whose use is uncertain at the present stage.

As an approach to resolve this issue, a move is taking root rapidly to reach a default colour space from among several colour spaces, also to provide, free software enabling vision of colour information and to make this a de facto standard. The sRGB conforming to ITU-R B 709-2 is proposed as the colour space, and is under scrutiny by IEC/TC 100 that handles multimedia systems and their constituent equipment. Also a colour information com-

pression technology called portable network graphics (PNG) and the rendering software have been proposed by the World Wide Web consortium.

## 5. Standardization of Colour Management for Multimedia Equipment

### (1) Assessing the Equipment Dependent Characteristics of Multimedia Equipment

As is evident from the cooperation in the standardization of the colour information exchange framework, it will be necessary, in order to achieve network based global colour reproduction properly, to establish the framework and to employ characterization data relating to the individual colouring equipment used within the framework. Each equipment is manufactured in conformance with its own design objectives, but the design objectives are not standardized, so these equipment may have a unique objective, based on the need for product differentiation. Therefore, the characteristics of individual colour information equipment should be measured and these equipment made usable within the framework of the data to compensate equipment dependent characteristics of each individual equipment, for the realization of equipment independent colour production and reproduction.

### (2) Specific Standardization Activities

A "Colour Management Task Force" (chaired by Hiroaki Ikeda) was established by the "Multimedia International Standardization Promotion Committee" (chaired by Mikio Takagi) of the Japan Standards Association, to study the Colouring Information Equipment Characteristics Measurement Regulation, and the draft of the regulation to measure the characteristics of CRT display systems was prepared in April 1996. This was proposed to IEC as the method of measurement of colour displays for multimedia Part 1: CRT displays, IEC 100/17/NP and, based on voting by countries concerned, this was approved as a new task. In this case, a plan to standardize the measurement methods relating to other colour information display systems was initially included in the draft, but based on an opinion by the secretariat (The Netherlands), it was decided that the project would include both colour information displays and the measurement methods for all types of colour information equipment.

Incidentally, since rapid progress is being achieved in the sector of multimedia, an International Task Force consisting of related experts was established at the time of proposal of the draft

standards, and technological opinion exchange was conducted through the Internet. At the present, an expanded project team has been established (TC 100/PT 61966), and the author was named as the leader of this project team. The international standardization activities of this project team are discussed below.

### (3) International Standardization Activities of IEC/TC 100

The tasks imposed on the task force for a period of slightly over two months were the following:

- \* Determining the scope of standardization of colour management by consideration of the present international standards and the industrial needs.
- \* Drafting the standardization task schedule in the sector of colour management.
- \* Submitting a task force report by September 1996.

As a result of these activities, the task force submitted its report at the plenary meeting of IEC/TC 100 held in Dresden on September 20, and the report was endorsed. The work performed, including the standardization work already in progress by IEC TC 100/PT 61966 are given below. The results are scheduled to be published as IEC 61966 series.

#### 1) Title of IEC 61966

The standardization work was named "Colour Measurement and Management in Multimedia Systems and Equipment."

#### 2) Scope of Application

IEC 61966 consists of several parts, and aims to set international standards applicable to measuring the colorimetric characteristics of diverse multimedia systems and equipment as well as to colour management. Here, multimedia systems consist of colour information input (production) equipment and colour information output (reproduction) equipment. Data obtained in conformance with each part should be utilized for evaluating the performances of related equipment, used as the equipment characteristics, and utilized in colour management for exchanging colouring information on a global scale.

The minimum requirement demanded by multimedia system manufacturers and system users is the clarification of colouring characteristics on specifications sheets, and this is information that is indispensable for colour management.



## Colour Management in Multimedia and International Standardization

Regarding colour matching between different colouring information equipment, international standardization is being advanced in parallel with the CIE activities for standardization in the sector of "colour appearance."

### 3) Architecture of IEC 61966

Depending on the international standardization work advanced through TC 100/PT 61966, the numbering may be changed or increased, but at present, they consist of the following:

- Part 1: General
- Part 2: Colour management in multimedia systems (100/43/NP)
- Part 3: Equipment using cathode ray tubes (100/47A/NP)
- Part 4: Equipment using liquid crystal display panels (100/44/NP)
- Part 5: Equipment using plasma display panels
- Part 6: Digital image projectors
- Part 7: Colour printers
- Part 8: Colour scanners (100/45/NP)
- Part 9: Digital cameras (100/46/NP)
- Part 10: Colour image in network systems
- Part 11: Impaired video in network systems

Regarding Part 3, a Technical Committee Draft was delivered to IEC participating countries in late May, 1997, and regarding Part 4, the working draft is being prepared by a domestic work committee with the aim of preparing the draft in Japan. Regarding Part 9, the preparation of a working draft was completed in May 1997 in connection with digital cameras including digital video cameras, and work was further commenced in connection with colour scanners (Part 8). An account of these recent activities was submitted to the IEC TC 100/AWG (Advisory Working Group) held in late February, 1997.

In mid-May, 1997, an American group headed by a proposer of the sRGB prepared a draft of a portion of Part 2, the standardization operations under PT 61966 were reported to the IEC/TC 100 participating countries, and these operations were publicized widely through JTAG2 that is coordinating imaging technology standardization in ISO/IEC. To promote the participation of new experts, the working drafts of Parts 2, 4, 8 and 9 were delivered to all participating countries in mid-May, 1997. Since opinions were

to be compiled by the end of August, it was decided that discussions would be held at the PT 61966 Makuhari meeting to be held on September 9.

Rapid progress is being achieved in multimedia systems and equipment, and even regarding the methods of connecting these systems and equipment, it will be necessary to advance international standardization of colour management while taking into account the high-performance serial bus IEEE 1394 standardized by IEEE and the simpler universal serial bus (USB).

## 6. Correlation with Other International Standardization Activities

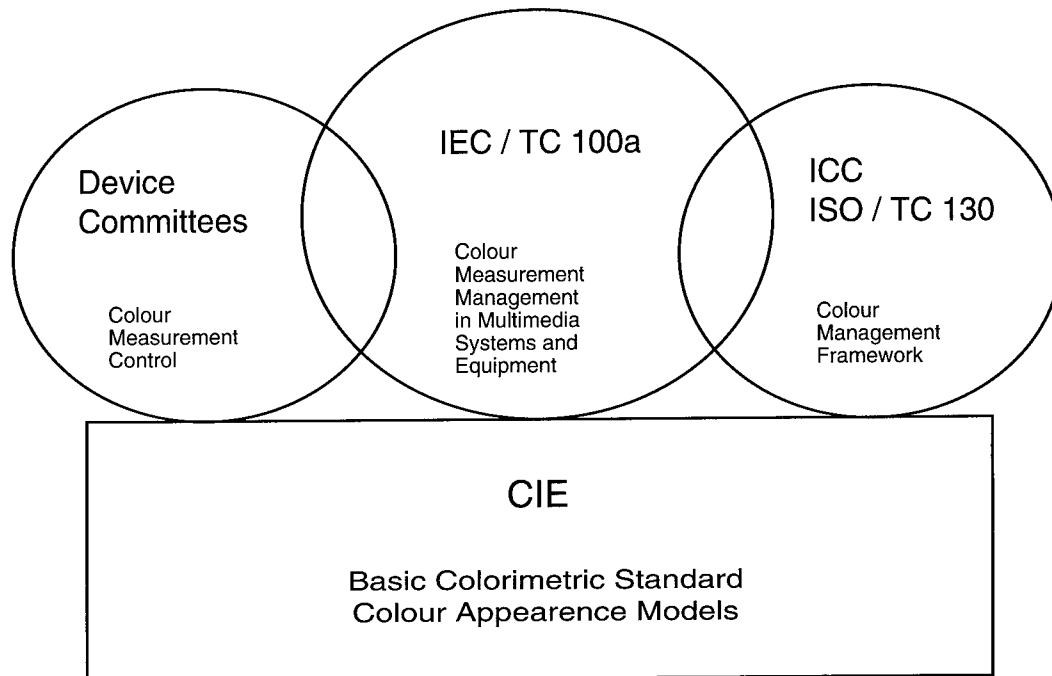
Standardization activities relating to colour reproduction have a long history, and are conceived as having been advanced primarily in connection with closed systems and semi-closed systems. On the other hand, few activities are being advanced for the direct international standardization of colour reproduction and colour management in multimedia systems which handle digitalized colouring information in open systems.

Total colour reproduction and its measurement control in open systems may be conceived as based on CIE's fundamental colorimetric standards, colour appearance models, and the correlation of the three fields shown in Fig. 2. The three fields consist of 1) standardization of colour measurement and control relating to functional products which comprise colour information systems and equipment, 2) standardization of digital colour information representation and its exchange protocol (such as ISO/TC 130 that commenced international standardization operations in conformance with ICC), and 3) standardization of colouring information equipment characteristics, measuring methods and measuring conditions in multimedia systems and equipment, aiming at total colour management.

## 7. Postscript

Multimedia is about to change the scope of human activities, and since this change is in progress quite rapidly, there is no time to be lost in the international standardization of related multimedia colour reproduction systems and equipment. This is fully recognized by the steering countries participating in IEC/TC 100, and there is a need to revise and accelerate international standardization.

**Fig. 2. Correlation in the Field of Colour Standardization**



As viewed from this perspective, the global scale operations of the task force in the period of voting on new work proposals primarily utilized multimedia such as the Internet, although it also utilized conventional media such as the postal system and the facsimile system. Media such as the electronic mail, FTP server and WWW server were mainly utilized. By these methods, opinion exchange and document preparation were advanced in 24 hour a day basis, and the objectives were attained without actually having to hold conventional meeting. This indicated a new phase of international standardization activity and attracted the keen attention of various countries.

The multimedia system is for all mankind, so there is a need for standardization from the aspects of human engineering, as in connection with the human interface. Coordination with the standardization groups which have previously been active in connection with colour is also vital. Therefore, it will be important to maintain close liaison with ISO/TC 159, ISO/TC 130 engaged in framework standardization, IEC/TC 39 engaged in functional product standardization, ISO/TC 171 engaged in the standardization of applied fields, and ISO/IEC JTC 1.

*JETRO, September 1997*

In Japan, there is a recognition of the importance of securing international initiatives in connection with colour management in the face of the advent of the age of full-scale multimedia, and the fact that survey and research activities are being activated from diverse approaches is quite encouraging for people such as the author who are specializing in colour management. We are apt to be overly concerned with conventional standardization frameworks and to disperse our domestic strengths, but the author would like to stress that it is now time for experts to concentrate their ideas in the new standardization framework (IEC/TC 100) and to produce with far-reaching results.

The author should like to express his gratitude to the distinguished experts who are participating actively in the IEC/TC 100/PT 61996 activities.

# NEW TECHNOLOGY & PRODUCTS

*This section provides information about recently developed technologies and products, divided into Advanced Materials, Electronics & Optics, Information & Communications, Process & Production Engineering, Construction & Transportation, Energy, Environment, and Biotechnology & Medical Science.*

## Advanced Materials

97-09-001-01

### Ferroelectric Material of Low Annealing Temperature and Nontoxicity

Kojundo Chemical Laboratory Co., Ltd. and the US company SYMETRIX Corp. have jointly marketed a newly developed ferroelectric material Advanced Y-1 for manufacturing semiconductors that features a low annealing temperature and less toxicity. Compared with the conventional Y-1 material (strontium-bismuth-tantalate), the new material (strontium-bismuth-tantalate-niobate) has an annealing temperature that is about 50 °C lower.

The annealing temperature was lowered by changing the composition ratios of the constituent materials. The advantages of this low annealing temperature are that the diffusion of substances in the annealing process, a cause of semiconductor problems, is reduced, the scope of selection of semiconductor materials is widened, and exfoliation of semiconductor lamination materials is decreased. The low annealing temperature also provides a number of distinct advantages to ferroelectric materials, such as better morphology at the upper surface, a large residual polarity is attained with a low voltage, there is no current leakage, and there is little deterioration in semiconductor data restoring function.

**\* Kojundo Chemical Laboratory Co., Ltd.**  
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Pref. 350-02  
Tel: +81-492-84-1511  
Fax: +81-492-84-1351

97-09-001-02

### Low Molecular Weight Organic Material for Durable High-Brightness Electroluminescence Elements

The Himeji Works of Chemipro Kasei Co., Ltd. and Prof. Kido of Yamagata University have jointly developed a low molecular weight organic material that substantially improves the brightnesses and durabilities of organic electroluminescence (EL) elements.

This new material enables formation of thin light-emitting membranes and is a complex material containing quinolinol ligands. The EL element made of this new complex features excellent electron transfer and resistance to crystallization, displays a luminous efficiency of 3.3% at 12 V, and provides a brightness of 27,000 cd/m<sup>2</sup> when operated at 14 V.

The brightness half-decay period indicating the newly developed organic EL element life expectancy is as yet unknown,

but it is definitely longer than that of EL materials containing the aluminum quinolinol (ALQ) complex.

**\* Chemipro Kasei Kaisha, Ltd.**

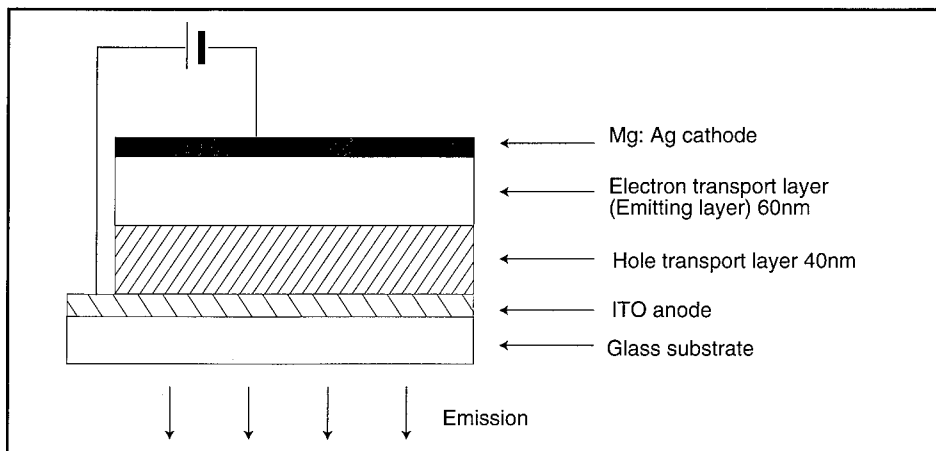
1611, Hamada, Aboshi-ku, Himeji-City,  
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97-09-001-03

### Porous Titanium Oxide Capsule with Large Specific Surface Area

A joint research team lead by Prof. Makahiko Abe and H. Sakai of the Faculty of Science and Technology, Science University of Tokyo, and Ishikawajima-Harima Heavy Industries, Ltd., has jointly created a porous titanium oxide capsule consisting of numerous hollow superfine holes and featuring a large specific surface area by applying the gel reaction generated on the surface boundaries between oil and water.

By controlling the sintering temperature, this new substance can be applied to the manufacture of cosmetics materials and photocatalysts. The research team plans further research to establish a mass production technique enabling particle di-

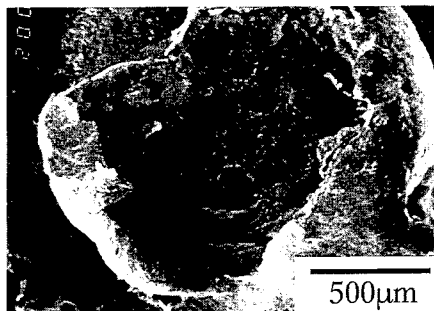


ameters to be adjusted flexibly as well as technology to combine various types of different materials. The research team created this porous titanium oxide capsule with a manufacturing technique that applies the oil gelling agent that is generally used to solidify household waste tempura oil, and named the new technique the Interfacial Gelling Reaction Process.

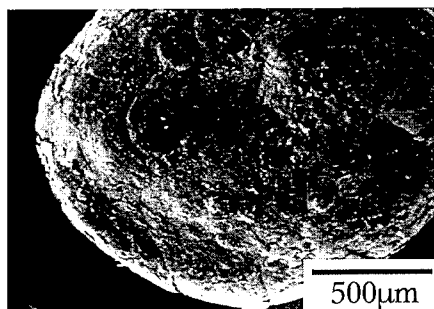
When alcohol is added to gel formed with a gelling agent, the gel is re-converted into liquid form. Sprinkling water into this liquid causes the ethanol molecules to transfer into water droplets and to create gelled film walls of meshed structure, or spherical capsules with diameters of about 1 mm which encapsulate water. The research team discovered that when a liquid titanium compound (titanium alkoxide) is mixed into the liquid at the stage of gel re-liquefaction and the water droplets increased, the titanium oxide inorganic compound is encapsulated inside the gel to create a hybrid organic and inorganic capsule. This hybrid organic-inorganic capsule was heated at a high temperature to combust and vaporize the organic gelling agent and the encapsulated water, which created a ti-

tanium capsule with a diameter of 2 mm and film thickness of 100  $\mu\text{m}$ .

According to the research team, adjusting the sintering temperature will permit the establishment of techniques for manufacturing various types of advanced materials such as photocatalysts and cosmetic



Slit capsule after heat treatment at  $1,000^{\circ}\text{C} \times 48$  high contrast ratio



Capsule without heat treatment  $\times 48$

raw materials. Also, by changing the reaction period and temperature, it will be possible to control the thickness of the capsule wall.

**\* Science University of Tokyo**

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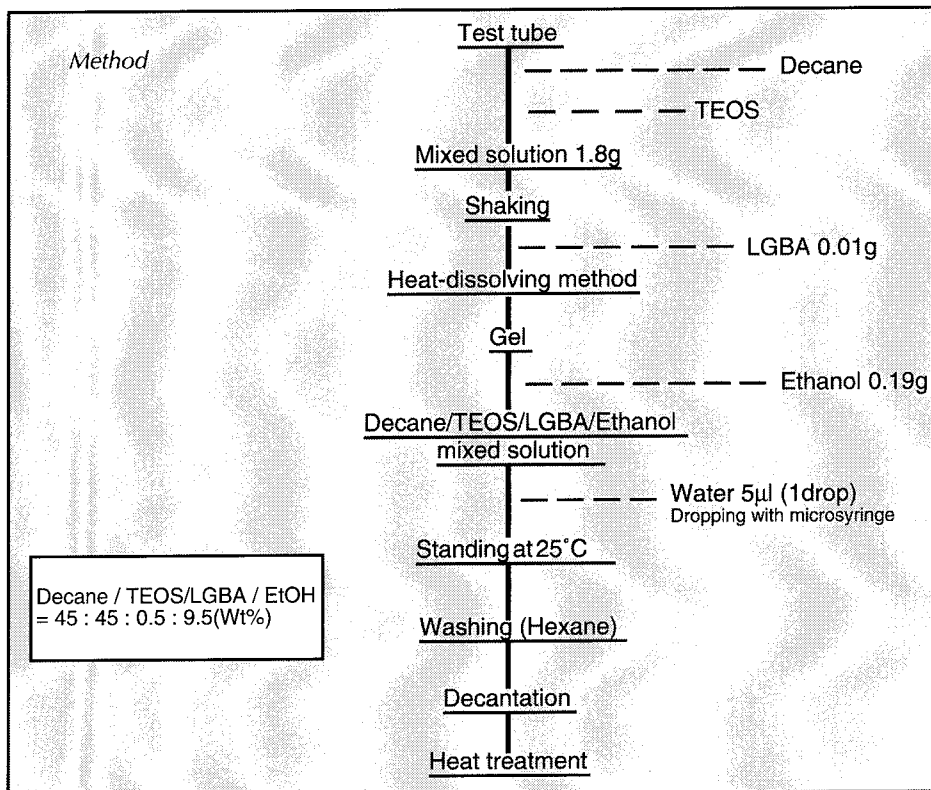
## Ceramic Material with Low Friction and Wear

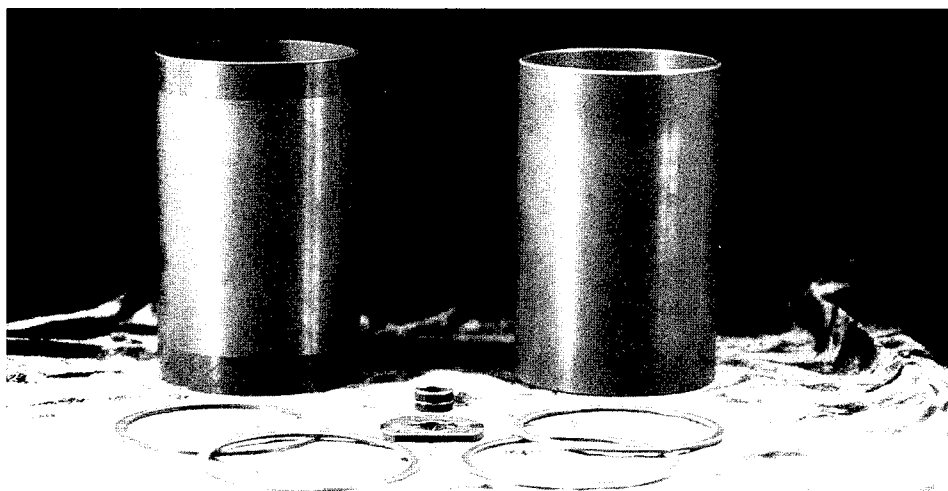
Isuzu Ceramic Research Institute Co., Ltd. has developed a ceramic material with low friction and wear for use in the manufacture of mechanical parts such as the engine parts and bearings of automobiles. This new ceramic material is produced by dispersing superfine particles of a ferrous compound with a particle diameter of less than 1  $\mu\text{m}$  into the parent ceramic material consisting of silicon nitride.

The new material friction and wear resistances were investigated by producing diesel engine piston rings and cylinder liners with the new material. Lubricating oil was fed into the cylinders, and acceleration-deceleration vehicle running tests were conducted repeatedly on city roads. Compared with parts normally made of cast iron, the friction and wear resistances of the new material were found to be reduced by 20%, and reduced by 70% compared with those made of silicon nitride materials which are used widely for producing bearings.

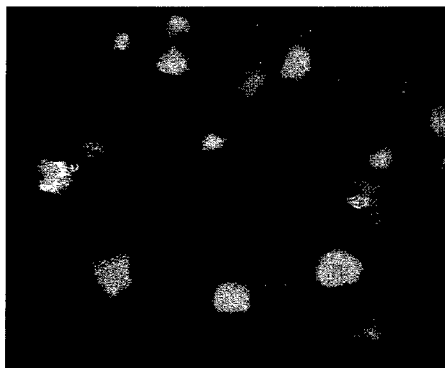
The company heated the ceramic material lightly at  $1,200^{\circ}\text{C}$  to leave fine porous holes, then impregnated a nitric solvent containing dissolved iron, followed by sintering at  $1,800^{\circ}\text{C}$ , and succeeded in dispersing the superfine iron compound into the material while preventing internal coagulation.

Automobile piston rings made of the new material are available at ¥2,000 - 3,000 each, which is about ten times higher than prices for ordinary piston rings, but the new piston rings can offset this disadvantage by reducing the fuel cost and improving the reliability through less friction and wear. When running the vehicles on city roads, fuel is conserved by about 10%. The research team anticipates commercialization





*Silicon nitride material with low friction and low wear properties*



*Microscopic view of silicon nitride materials*

of the new ceramic material for manufacturing the parts and bearings for large diesel engines. It is prepared to distribute samples of the new material upon request. This new material project has been supported by Synergy Ceramics Projects of the Industrial Science and Technology Frontier Program Promoted by AIST, MITI Japan.

**\* Isuzu Ceramic Research Institute Co., Ltd.**  
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at the front part, resulting in fine liquid droplets sputtered on the wafer synthesizing the thin film.

With the new system, the electrode structure has been improved and formed in such a manner that the electrode encircles the front part of the metal, and a large cylindrical arc discharge electrode envelopes the metal/electrode assembly, so that the liquid droplets are not sputtered on the wafer. When an arc discharge occurs on the assembly lateral face, vapor is directed toward the wafer, but the liquid droplets are adhered on the lateral face and not sputtered on the wafer. The structure is rather simple and the system is easy to fabricate. Experiments showed that quality ferrous thin films can be synthesized without any adhesion of liquid droplets. In addition, since only raw material is used, few impurities are generated.

Arc discharge enables plasma to be formed even from metals of high melting points, also from non-metallic substances which pass an electric current. Therefore, hard carbon films including virtually no hydrogen can be synthesized, which are difficult to produce by the chemical vapor deposition (CVD) technique. The new system is applicable to the manufacture of various types of thin films, even films of superfine structures like those used in LSIs.

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## Electronics & Optics

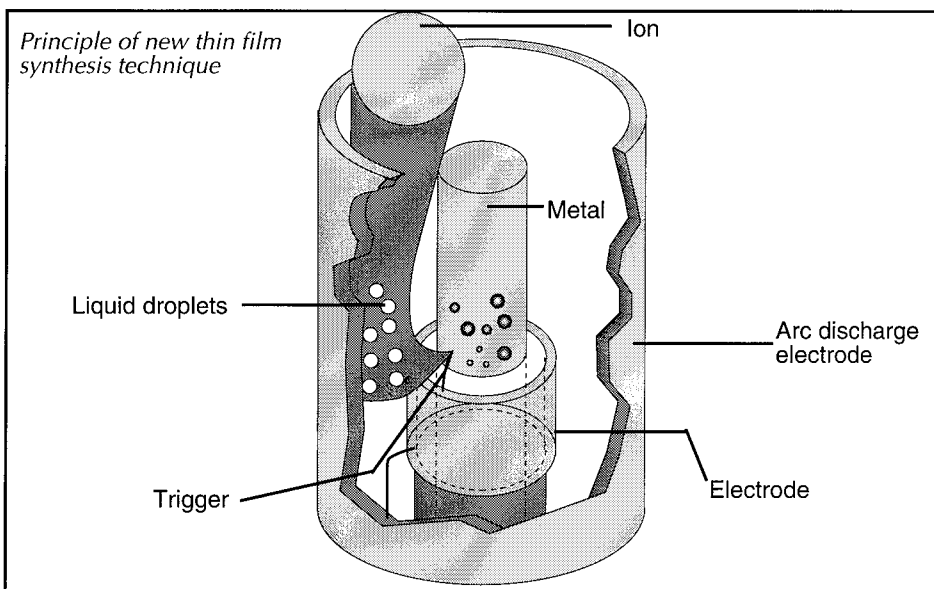
97-09-002-01

### Thin Film Synthesis Technique Using Metal Plasma

A. Chayahara and a research team of the Osaka National Research Institute, Agency of Industrial Science and Technology, have developed a new type of thin film synthesis system that uses metal plasma.

When generating a plasma containing ionized metal atoms, an electrode is formed in part of the metal and a pulsating voltage is impressed on the electrode from the power unit to transmit a trigger voltage to the metal to cause an arc discharge. With conventional systems, the electrode is formed on the front part of the metal, so the discharge is naturally formed

*Principle of new thin film synthesis technique*



97-09-002-02

## World's Fastest System for Measuring Polarization Mode Dispersion

Santec Photonics Laboratories has developed the world's fastest system (order of subfemtoseconds) that very accurately measures the polarization mode dispersion (PMD) that is defined as the transmittance delay time of specific rectilinear polarized waves and which is utilized to evaluate the performances and quality levels of optical fibers and optical components used in optical communications systems.

The polarization mode dispersion measuring system applies a unique spatial Michelson interferometer with the function of searching for polarized wave axes, and the resolution, measuring speed and measuring range are five times better compared with those of conventional counterparts. It is sold at a domestic price of ¥7,850,000 and features the following characteristics.

Excellent resolution: 0.6 fsec (world's fastest resolution)

High-speed measurement: 5 sec in 10 psec scanning 60 sec in 120 psec scanning

Wide measuring range: 120 psec max.

Broad measuring scope: Optical components in general (optical isolators, optical couplers, optical fil-

ters, etc.), optical fibers (SMF, DSF, PANDA, EDF, etc.)

Measurement results: PMDp-p (direct value of interference peak), PMD

gaussian (computing of mode coupling samples in gaussian proximation)

Visual display:

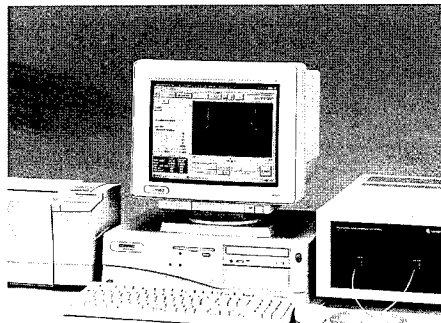
Visual display of measurement results on two-dimensional graph in delay time-dispersion volume

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PMD-6000B

combination with the newly developed welding machine enables the sputtering volume to be reduced by 30% compared with conventional types of welding machines.

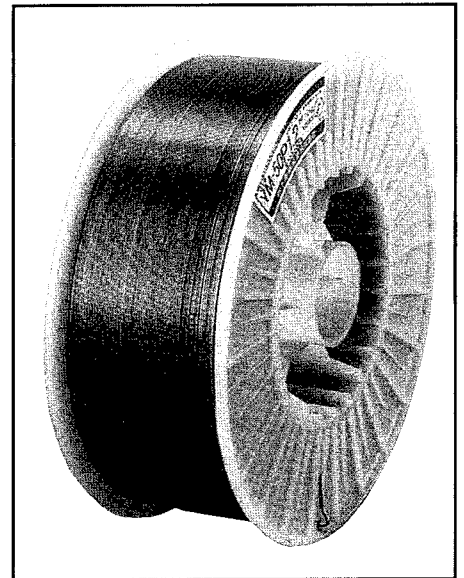
### \* Sumitomo Electric Industries, Ltd.,

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Welding wire (YM-50P)

## Machinery & Mechatronics

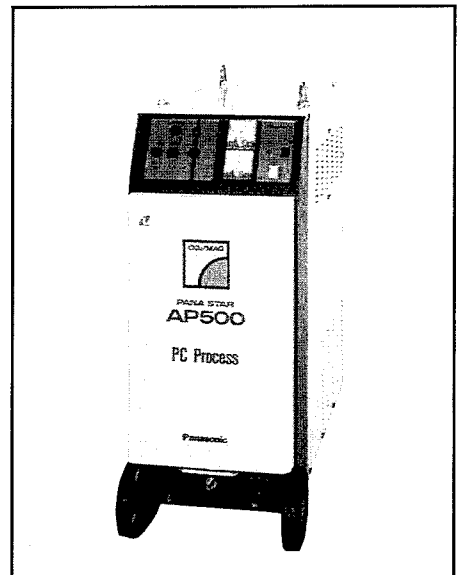
97-09-003-01

## Welding Wire with Minimal Generation of Sputtering

Sumitomo Electric Industries, Ltd., jointly with Matsushita Industrial Equipment Co., Ltd. and Hoshi Industry Co., Ltd., has developed a welding wire YM-50P featuring minimal sputtering generation. This welding wire was developed to be compatible with a new type of welding machine developed by Matsushita Indus-

trial Equipment Co., Ltd., which uses inexpensive CO<sub>2</sub> gas as the shielding gas and controls the welding current in pulse form, by which sputtering is reduced to about one-half.

With this welding wire, the components of the alloys are added into the raw materials and adjusted to minimize the size of generated weld beads, by which the sputtering volume is suppressed at a low level with stability. Using this welding wire in



New welder (Panastar AP500)

## Information & Communications

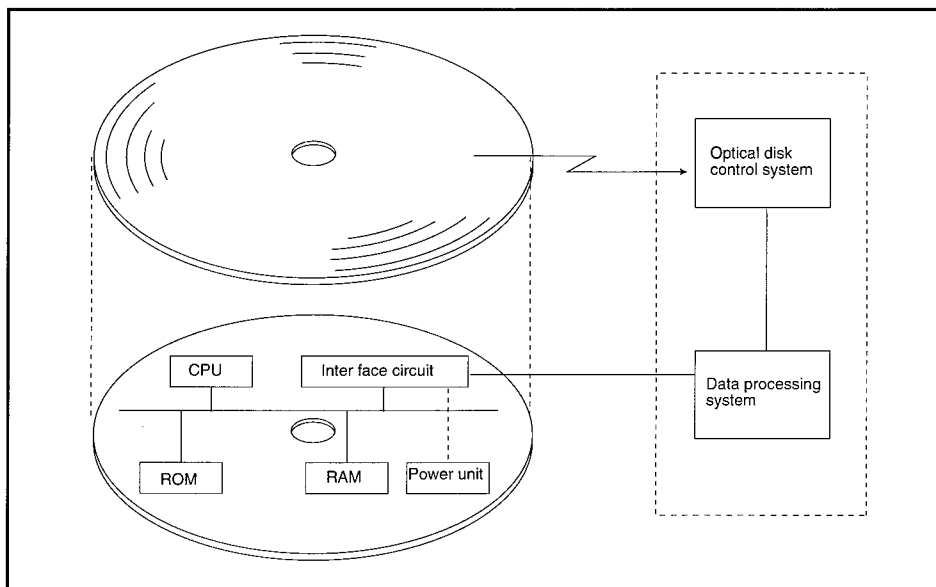
ID Structural diagram

97-09-004-01

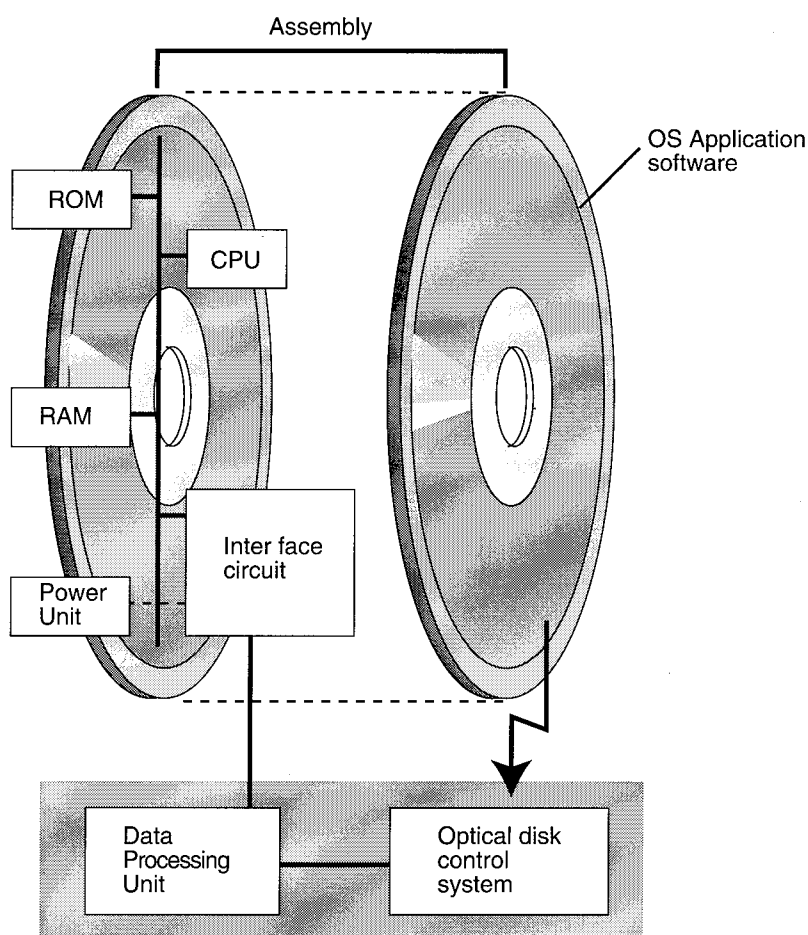
### Intelligent Disk with Personal Computer Function

Optrom, Inc. has developed an optical disk incorporating the kernel components of computers such as the CPU, ROM and RAM. Upon its commercialization, this system is anticipated to bring about a major revolution in computer hardware and software.

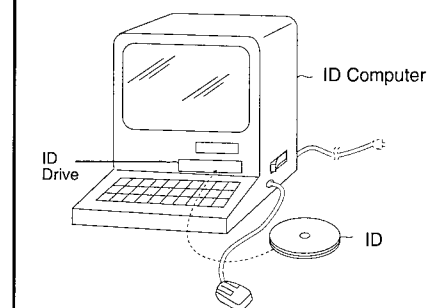
Simply inserting an optical disk that may be regarded as an IC card into a special-purpose drive system will enable the use of a hardware system comprised only of a display unit and keyboard and which has the same functions as a personal computer. Since it will be necessary to use special-purpose hardware, the company plans



Configuration of intelligent disk



ID Computer system



to work together with a personal computer manufacturer to commercialize this advanced optical disk.

The thin disk is called the Intelligent Disk (ID). In addition to the CPU, ROM and RAM, the disk reverse side incorporates electronic circuits such as communications functions. The upper side carries ordinary optical disk recording functions such as CD-ROM and DVD. The special-purpose rotary drive system mounts a superminiature antenna for radio wave transmission, and conduction coil for power generation on the disk side for use as circuit power unit.

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## Process & Production Engineering

97-09-005-01

### Compact Wide Scan Angle Resonance Scanner for Laser Beam Scanning

Optron Co., Ltd. has developed and started selling from June this year three models in the CS Series of compact wide-amplitude resonance scanners for laser beam scanning.

The company is using its own scanners, but the polygon mirror available in general is overly large for incorporation in the sensor unit, the motor service life is also short for using the scanner in factory automation (FA) equipment, and the power consumption is rather high. The company had been engaged in research to resolve these problems. The new CS Series scanners come in three models, all compact and featuring a wide amplitude, low power consumption rate, and can be applied to various types of battery-driven equipment. The domestic prices for these standard products are ¥30,000-50,000, depending on their specifications.



Compact wide-amplitude resonance scanners for laser beam scanning

These products use a mirror to scan the laser beam to left and right in a line. Conventional types of resonance scanners twist a wire and utilize the wire return force, but in this case the wire becomes long and large when a wide scan angle is required, making the scanner large. The CS Series scanners introduce a proprietary control technique that uses a coiled spring in place of the wire, which succeeded in reducing the amplitude.

Therefore, these scanners can be built into equipment such as measuring equipment with ease, and since there are no wearing parts, the service life has been prolonged by  $10^{11}$  times, or is usable semi-permanently. Also, a broad range of amplitudes is available, which are 40 degrees with a standard mechanical type, 100 degrees with a wide-scan-angle type, and with an optical scanning angle, wide scanning of 200 degrees is possible.

These scanners are characterized by low voltage and low power consumption rate (10 mW at  $\pm 20^\circ\text{C}$  and 200 Hz), so can operate with batteries. The square model ( $11 \times 25 \times 12$  mm), the cylinder model ( $16$  dia  $\times 16$  mm) and extra-wide amplitude model ( $10 \times 40 \times 20$  mm, scan-angle  $\pm 50$  degrees) are available, and the frequency range is 50-500 Hz. However, a high-speed type of over 1 kHz or a type enabling two-dimensional scanning with a single mirror are also available to special order. With the two-dimensional scanning type, the scanning frequencies in both the X and Y directions can be selected, and are therefore optimum for use with two-dimensional bar code readers.

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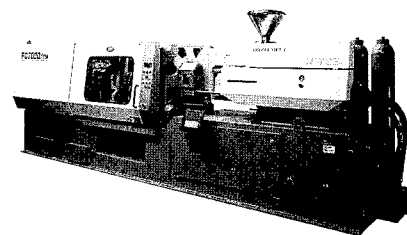
97-09-005-02

### FC Series High Quality Thin-walled Product Molding Machine

Nissei Plastic Industrial Co., Ltd. has marketed an injection molding machine for producing thin-walled products such as diningware. The machine introduces a uniquely developed injection mechanism that enables high speed operation and stable molding. In addition, the maintenance cost has been reduced by using a sturdy clamping mechanism.

The FC Series machines consist of four models: Model FC 4000/TM with a clamp-

ing force of 180 ton and three models with clamping forces of up to 360 t. These FC Series injection molding machines feature a combination of the unique high-speed, high-stability direct pressure clamping mechanisms and triple melt injection systems enabling super-precision stable plasticizing and measuring, which led to the development of these high-cycle machines for producing high quality thin-walled products.



Injection molding machine for producing thin-walled products

The clamping mechanism is designed with a clamping stroke and mold thickness specific for the high speed molding of thin-walled products, and a highly rigid platen plate is used to enable multi-cavity molding. To stabilize the high speed and slow down the opening and closing motions, a high-speed dry cycle time of 1.7 s (for the FC 4000 model) has been introduced.

The injection mechanism adopts the triple melt injection molding system consisting of a plasticizing screw, a uniform plasticizing acceleration unit and an injection plunger, and maintains the material pressure and temperature at a constant level to realize stabilized plasticization and kneading which are the most vital conditions for high-cycle molding. In addition, the mass of the plastics melts is measured very precisely to eliminate disparities in product weights and dimensions, by which accurate high-cycle molding of thin-walled products is possible without using a closed loop control technique.

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## Construction & Transportation

97-09-006-01

### Alkagel (Alg-Ca Gel) Shielded Earth Excavation Technique Gentle to the Environment

Kajima Corp. has developed the Alkagel Technique that is a ground excavation technology with an earth pressure balanced shield machine. This technique is gentle to the environment and is ideal for application to riverbeds consisting of a mixture of sand, gravel and large rocks. An additive consisting of seaweed extract is used to easy to dig, and the extracted earth is also usable for preparing embankments.

This technique was proved by the remarkable results achieved when applied to the construction of a sewage conduit system in the basin of the Chikuma River in Nagano Prefecture as well to the construction of the Azusa River Siphon System in the Jyukka Seki Yokobori Region. Kajima Corp.'s subsidiary Taiko Trading Co., Ltd.

is marketing the additive as well as related manufacturing expertise.

With the Alkagel Technique, an earth additive consisting primarily of sodium alginate extracted from seaweed is injected into the facing to make the soil fluid and easy to dig, and a calcium chloride aqueous solution is added into the earth in transit on the screw conveyor to gel the fluid earth and make it easy to discharge. Sodium arginate is a natural polymer obtained by alkali extraction of calcium alginate that is a seaweed component, and is a safe compound that is used as a food additive. Sodium alginate is not gelled when simply dissolved in water, but when polyvalent metal ions other than magnesium ions are added, a strong insoluble gel is formed through ion exchange. Sodium alginate is mixed with the clayey earth and a water-soluble polymer-based viscosity promotion agent, then injected into the soil cham-

ber as a soil additive to give the dug earth the appropriate fluidity to enable smooth digging of the earth consisting of sand, gravel and large stones. Polyvalent metal ions are added during its transit on the screw conveyor, by which fluidity is lost gradually to prevent the seepage of water from the dug earth and conveyor system. The polyvalent metal ion is inexpensive calcium chloride.

The dug earth conveyed by the screw conveyor discharges its water content rapidly due to self-weight in the stockyard and becomes solid again, so can be conveyed easily with dump trucks without requiring any lime or cement-based solidification agent. The conveyed dug earth has a neutral pH value and can be used conveniently as an embankment material, while the discharged water requires no special treatment and can be discharged directly into a sewage system.

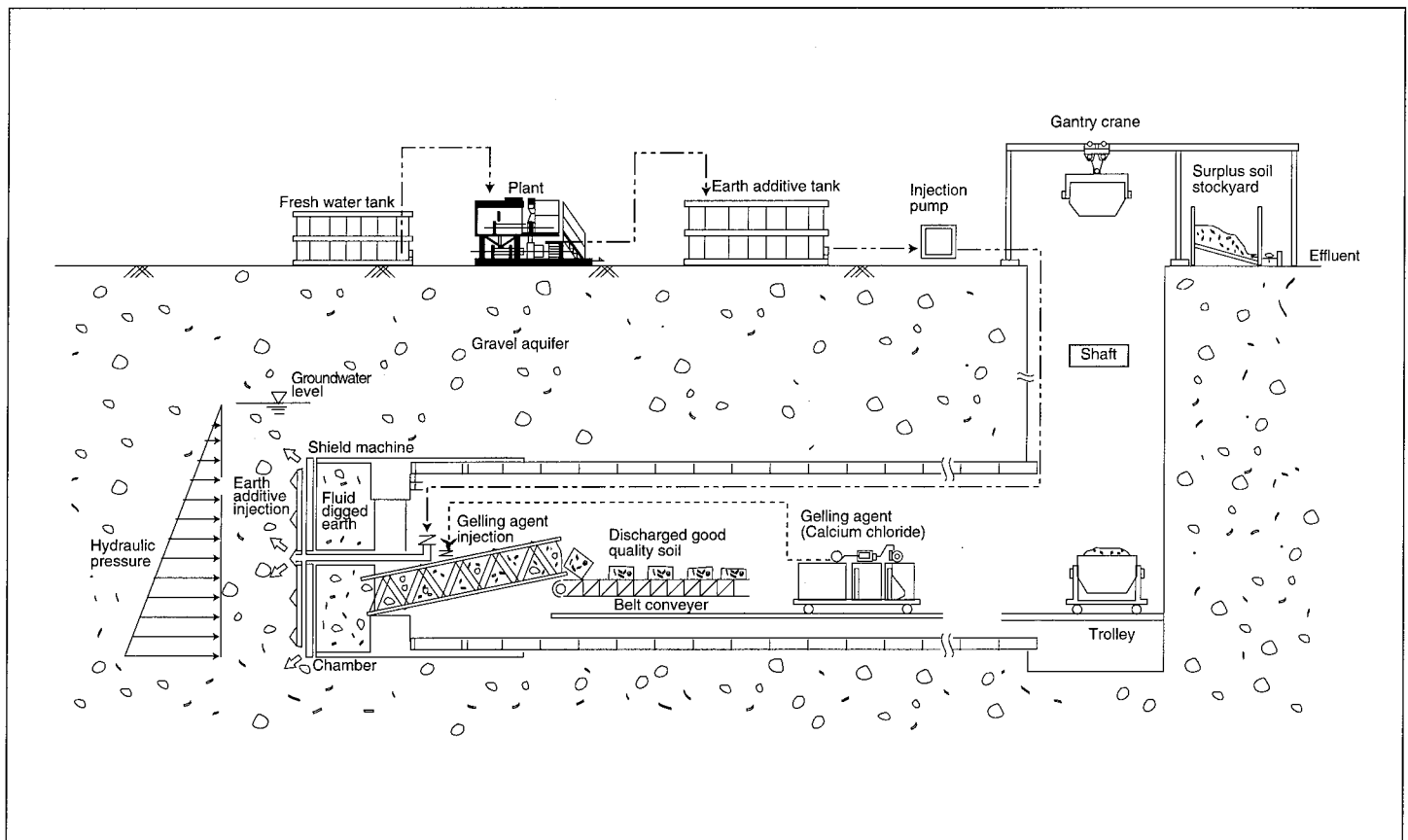
#### \* Kajima Corporation

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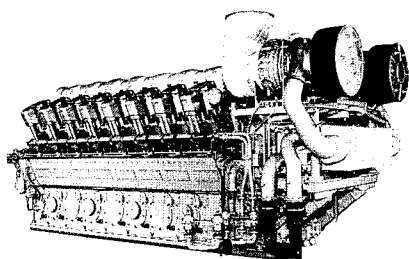


Alkagel technique concept chart

97-09-006-02

### Medium-Speed, High-Output Diesel Engine

Niigata Engineering Co., Ltd. has started marketing a newly developed medium-speed, high-output diesel engine that features the world's lowest level of fuel consumption and highest level of efficiency, and is available in the output range from 6,660 kW to 9,990 kW. These diesel engines are available under the brand name of Model V34H(L)X with a cylinder bore of 340 mm.



Medium-speed, high-output diesel engine

These engines come in three models having 12, 16 and 18 cylinders, and whereas structural strengthening had been necessary to increase their outputs, this was achieved successfully not by conventional methods but rather by a new method of approach. The performances and unit costs of the target parts were set beforehand, and the development of these parts undertaken by the concurrent engineering method of engaging in the developmental projects simultaneously and in parallel without setting any limits to the development schedules, by which the manufacturing costs of these parts were decreased considerably.

The main characteristics of the Model V34H(L)X diesel engine can be summarized as follows. The output has been increased by about 30% compared with conventional types of diesel engines. The specific output rate that represents the degree of high output is 24.5 MPa.m/sec, which lies on the world's highest level, as compared with the company's present high-output level of 22.5 MPa. The design value of the maximum combustion pressure that improves the fuel consumption performance was set at 19.6 MPa (200 kgf/cm<sup>2</sup>), as compared with the value of 17.7 MPa

(180 kgf/cm<sup>2</sup>) of the company's present models. The target values of the break mean effective pressure and the mean piston speed were set at high levels and improved by 11% and 33%, respectively, compared with conventional diesel engines. Further, the NOx emission volume was suppressed to less than 950 ppm (to 13% in oxygen conversion), which enables the use of low-quality fuels. The reduction of fuel and lube oil consumption rates has improved the economy considerably. An-

other advantage is that the engine pipings have been reduced to a minimum for substantial maintenance ease. Hydraulic tools are usable for the assembling and disassembling, which decreases maintenance and inspection costs substantially.

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## Energy & Resources

97-09-007-01

### Diesel Power Generation System Using Spent Vegetable Oil as Fuel

Niigata Engineering Co., Ltd., Nichirei Corp. and its subsidiary Manyo Food Co., Ltd. have jointly developed a diesel power generation system that uses spent vegetable oils such as tempura oil and frying oil as its fuel. This is the first diesel power generation system utilizing spent vegetable oil and was developed by mixing 20% of heavy fuel oil into spent vegetable oils.

A huge volume of spent vegetable oils is discharged as industrial waste. The companies had been studying the feasibility of utilizing these oils as the fuel for private power generation system from 1994. They remodeled the conventional type of diesel power generation system, and redesigned the fuel injection system parts such as the fuel cam and fuel injection pump with special specifications to enable the system to be run with spent vegetable oils. Combustion chamber parts such as exhaust valves and cylinder liners were redesigned and made durable for the combustion of spent vegetable oil. The mixing and fuel supply system of spent vegetable oil and heavy fuel oil can change the mixture ratio to cope with fluctuations in the volume of discharge of spent vegetable oils. In addition, the power generation system is designed to effectively utilize the waste heat

of engine as the heat source for adjusting the fuel viscosity.

Mixing heavy fuel oil and spent vegetable oils provides a number of advantages. Heavy fuel oil is mixed to some extent, but spent vegetable oils do not contain sulfur, so there is less generation of sulfur oxides (SOx) compared with the use of various heavy oils. The generation of nitrogen oxides (NOx) is also decreased by using vegetable oils and heavy fuel oil in a mixture. The soot density is also much less and hardly any smoke is generated compared with the combustion of heavy fuel oil. Further, the fuel cost is lower than the method of chemically treating spent vegetable oil and converting it into light oil.

The diesel power generation system presently under fabrication features a power generation capacity of 475 kW (700 HP) and consumes 110 l/hr of spent vegetable oils. The first system will be installed in Manyo Food's Head Plant in late October this year, and the company plans to supply one-half of its electricity consumption volume (average of about 3,260,000 kWh/year), by the private power generation system.

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97-09-007-02

## Ecological Organic Waste Recycling System

Obayashi Corp. has commercialized an ecological recycling system Obayashi BIMA System for methane gas power generation and compost manufacture by utilizing livestock and food processing system wastes. An order for the first commercialized plant has been received from the Yagi Town Compost Center (temporary name) of Yagi Town, Kyoto.

With this system, organic wastes are mixed and treated in a special type of digester BIMA, and electricity generated with the biogas (methane gas) formed in the process. The digested sludge is dewatered and the cake converted into compost. The waste is treated with the digester tank by consum-

ing little energy, so this ecological organic waste treatment system enables natural resources to be utilized most effectively.

The wastes are fed into the BIMA digester and disintegrated through anaerobic digestion by microorganism action. The pressure of the biogas (methane) generated by waste treatment is utilized as the energy to mix the digestion tank, so the system is operable with an extremely low running cost without requiring any special power. The tank is designed for powerful mixing without clogging, and can treat even solid wastes of high concentration. It has no mechanical mechanisms inside, so is a maintenance-free system.

At the waste recycling system of the Yagi Town Composting Center, the excrement of 650 cows and 1,500 pigs, together with

about 5 t of bean-curd lees, are fed into the BIMA digester tank daily and treated by anaerobic microorganisms. As a result, about 2,000 m<sup>3</sup> of biogas, containing about 65% of methane gas, are discharged daily together with digested sludge.

The methane gas is utilized for power generation of maximum 134 kW/hr, which supplies the power required by the Compost Center. The digested sludge is dewatered and the cake fed into a composting facility for conversion into compost. The separated water is treated and ultimately discharged into a nearby river.

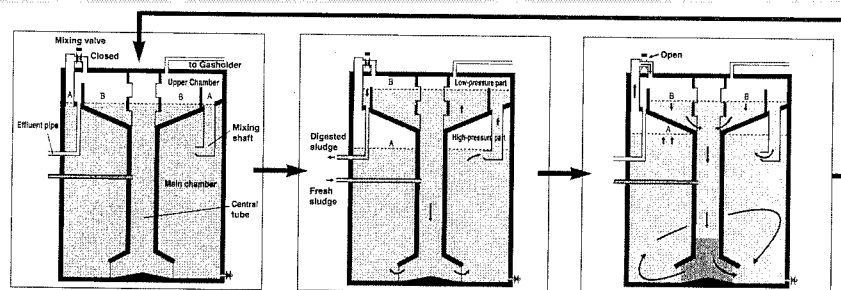
### \* Obayashi Corporation

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Phase 1

**Start**  
The liquid surface A of the main chamber and the liquid surface B in the upper chamber are on the same level. The mixing valve is closed.

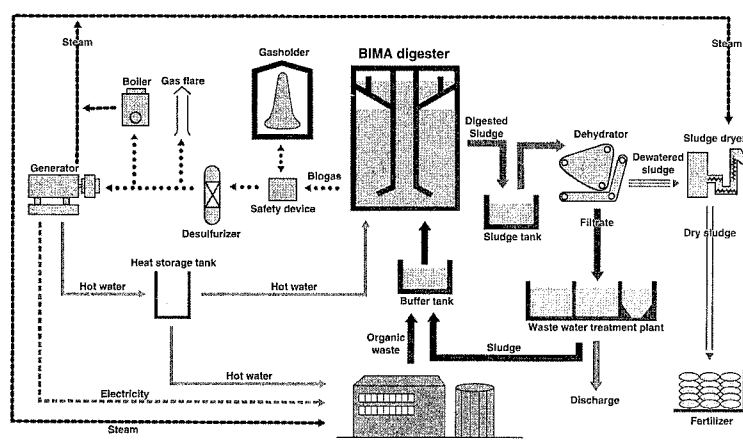
Phase 2

**Sludge Inflow and Digested Sludge Outflow**  
The liquid surface A is lowered by the produced gas in the main chamber and the liquid surface B is raised simultaneously. After the liquid surface B reaches the required highest level, the fresh sludge is fed into the central tube and the digested sludge is discharged.

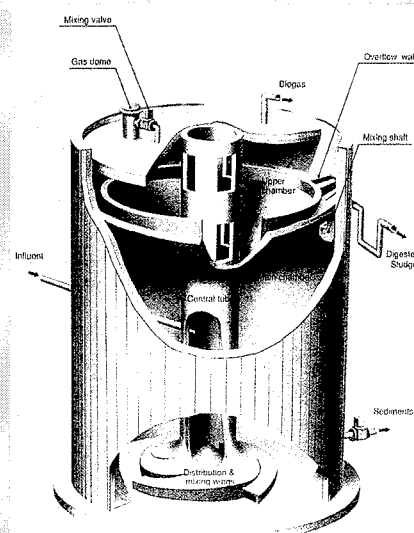
Phase 3

**Mixing**  
When the mixing valve is opened, the gas pressure of the high-pressure and low-pressure part reaches the same level. The liquid in the upper chamber is flowing down into the main chamber and the contents of the main chamber are perfectly mixed.

### Mixing mechanisms of the BIMA digester



Obayashi-BIMA system flow



BIMA digester structure

## Environment

97-09-008-01

### System for Pyrolysis Treatment of Vinyl Chloride

Motoda Electronics Co., Ltd. has developed and started marketing a system for the pyrolysis treatment of vinyl chloride by an odorless, non-smoking and environmentally friendly technique. Combusting

waste vinyl chloride intact will generate highly toxic dioxin, so the waste is heated and undergoes pyrolysis treatment inside an oxygen-free system. Up to 2.5 t of waste vinyl chloride can be treated daily.

The system is called Motoda pyroly MP2000RK. The waste is fed into the system deprived of oxygen, then heated to

vinyl chloride, so simply loading the waste to be treated on carts will enable other operations to be accomplished automatically. The system is 5.7 m wide, 2 m deep and 2.3 m tall, or rather compact, so can be transported to its installation site on a truck and installed with ease. The system is sold at a domestic price from ¥70 million to ¥100 million, depending on its specifications.

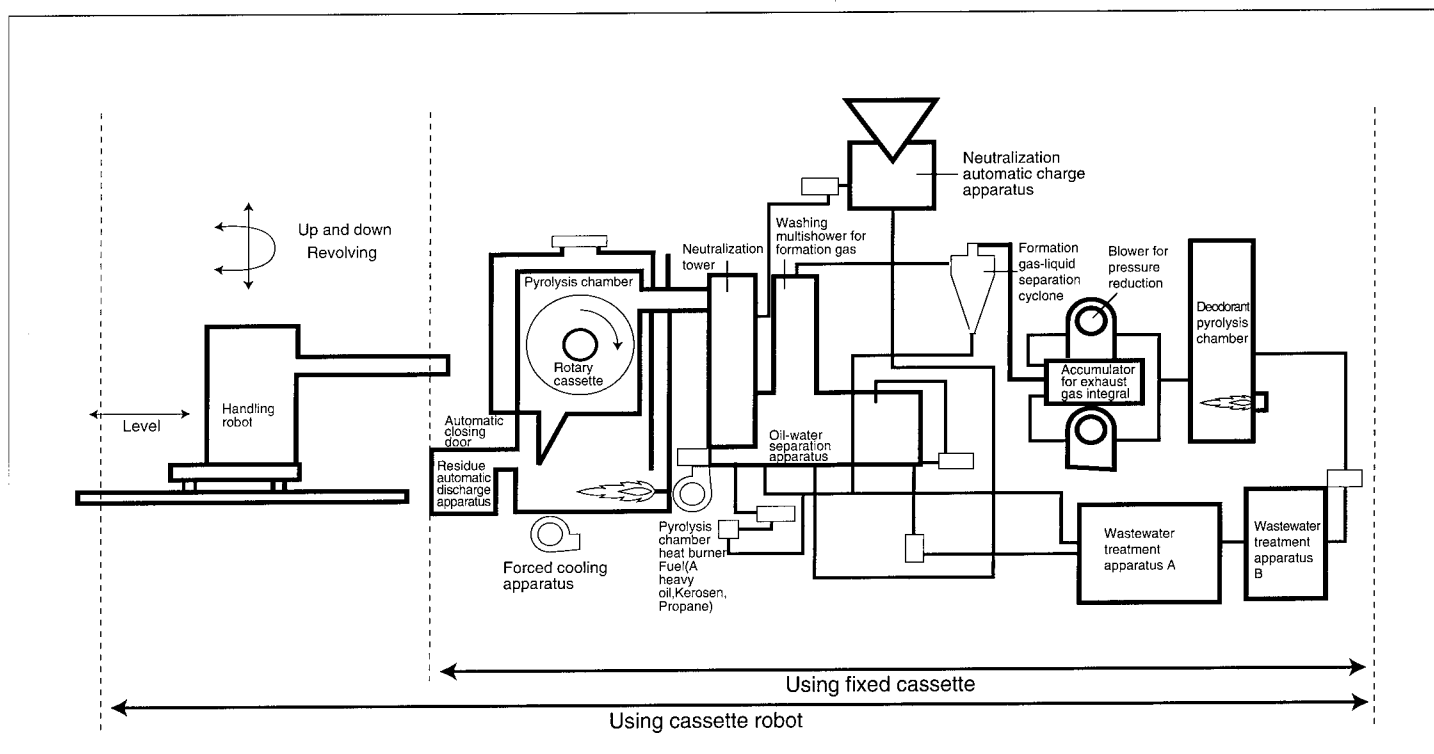
\* **Motoda Electronics Co., Ltd.**

Public Relations Dept.

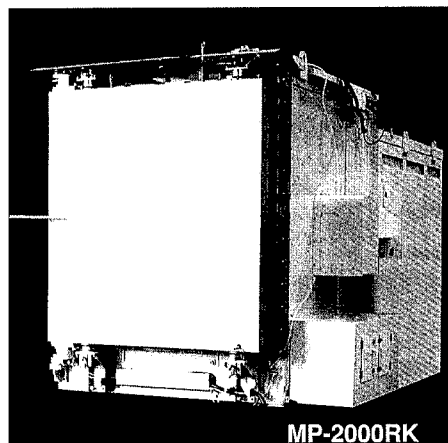
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System for pyrolysis treatment



MP-2000RK

Motoda pyroly

500 °C, and the hydrogen chloride gas generated in the process washed with a calcium carbonate emulsified liquid for neutralization. After the treatment only non-harmful substances remain such as powdered carbon, dioxide and an oily substance. When combustion is performed in the presence of oxygen, the chloride components in the waste are bonded with oxygen to generate dioxin, so previously there had been a need to devise some separate means to treat the generated dioxin.

The new system is equipped with an automated mechanism to feed the waste

97-09-008-02

### Fire Alarm Apparatus Using Ultraviolet Radiation

Souki Co., Ltd. and Hochiki Co., Ltd. have jointly developed a fire alarm apparatus Video Kanshien using ultraviolet radiation. The apparatus can detect a small fire about the size of a lighter flame that is about 5 m away, sound an alarm and, at the same time, monitor the state of the surrounding region. The companies anticipate the new fire alarm apparatus will be introduced into warehouses as well as furniture and bedding goods sales outlets where the use of fire is absolutely forbidden.

The new fire alarm apparatus introduces the ultraviolet radiation type fire detector SQH-50 produced by Hochiki and which responds with high sensitivity even to small flames. The apparatus also consists of an alarm switcher and a special-purpose camera. When a fire is sensed, an alarm is sounded and the trade's first special-purpose camera monitors the state of the surrounding region. A time lag of about 10 s is provided for sounding the alarm after sensing a flame. Setting only the alarm

without working the camera is also possible. By using the apparatus in combination with SQH-50, up to a maximum of five fire alarm units can be installed.

The fire alarm apparatus with monitoring camera is marketed at a domestic price of ¥173,700.

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## Biotechnology & Medical Science

### 97-09-009-01 Strongly Acidic Water With Powerful Sterilization Effect and Great Safety

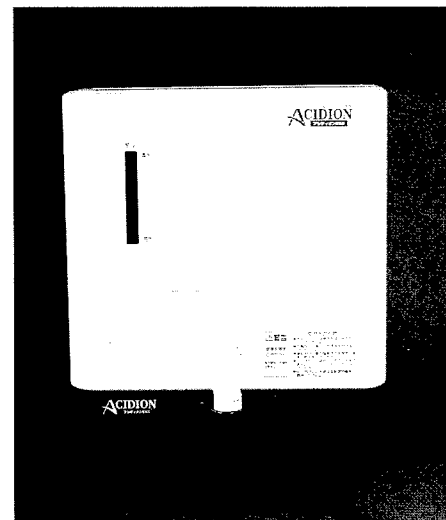
Nihon Aqua Co., Ltd and National Co., Ltd. have jointly started marketing a newly developed Super Soft Water Generator Acidion 250 that generates strongly acidic water with powerful sterilization effect and great safety.

Acidion 250 was developed on the concept of utilizing to the maximum limit the highly effective sterilization effect of chlorine, and is designed to generate strongly acidic electrolytic water (pH value of 5-7) based on a unique electrolysis system. To retain the bacteria removal effect, the chlorine density will have to be changed in conformance with the spe-

cific purpose. Acidion 250 can be set flexibly to 15 ppm, 30 ppm or 60 ppm.

Pathogenic 0-157 coli or methicillin-resistant Staphylococcus aureus (MRSA) are killed as quickly as within 5 s. Supersoft water is generated from a special-purpose raw water that is first decomposed by electrolysis to generate hypochlorous acid and hypochlorous acid ions. Hypochlorous acid that is chlorine-based penetrates into the cell membranes of bacteria, destroys enzyme systems and kills the cells.

Since the water pH value is close to neutral, the hands and skin are not irritated so much, and problems such as the deterioration of sterilization effect or generation of chlorine gas due to the mixture of organic substances, which are associ-



Super Soft Water Generator Acidion 250

ated with conventional types of strongly acidic electrolysis water, are eliminated. The system is marketed at a domestic price of ¥1,680,000.

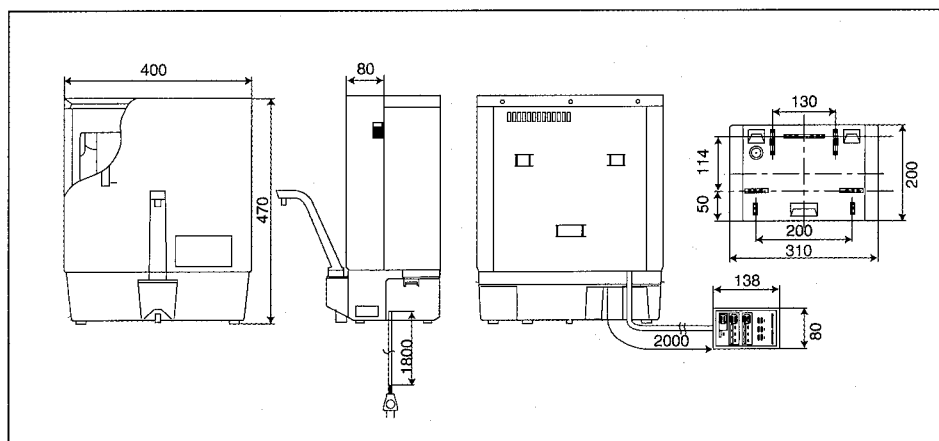
**\* Nihon Aqua Co., Ltd**  
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### 97-09-009-02 Yeast Strain Decomposing Some Anthraquinone Dyes

Nagoya Municipal Industrial Research Institute has shown that the yeast strain *Pichia anomala* effectively decomposes some anthraquinone dyes.

The chemical industry uses many synthesized chemicals, and many new products with unprecedented structures are being added to the list. Many of these products are harmful, hard to degrade, and persistent in the natural environment, arousing the grave concern of the public. Synthetic dyes, which are used in all industries, with about 70,000-metric-ton annual production in Japan, are an example of these products.

To decolor waste water containing synthetic dyes, conventional methods rely on physical or chemical processes such as adsorption, concentration, and chemical oxidation. Unfortunately, these are costly, and often result in toxic by-products. Researchers are trying to develop bioprocesses for dye degradation, which will be an ecofriendly technology.



Dimensional drawing

The Institute focused on anthraquinone dyes, an important family of synthetic dyes, and has been investigating into dye degradation by microbes. The yeast *Pichia anomala* attacks a mutagenic (carcinogenic) dye so that its molecular structure is modified by reduction, deamination, and dehydroxylation. As a consequence, the mutagenicity disappears. A cell-free extract from yeast strain also works as a catalyst for decoloring the dyes.

Current challenges are the time required for the process, and some dyes having such functional groups conferring immunity from the yeast.

**\* Nagoya Municipal Industrial Research Institute**

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97-09-009-03

### Oligosaccharides Confirmed to Promote the Proliferation of Bifidobacteria

Morinaga Milk Industry Co., Ltd. has confirmed the effectiveness of oligosaccharides to selectively promote the proliferation of bifidobacteria in the intestines. After feeding with liquid food supplemented with oligosaccharides to mice that had been orally inoculated with bifidobacteria, it was confirmed that bifidobacteria became the predominant component of the intestinal microflora in the mice. In addition to promoting the growth of the bifidobacteria introduced by inoculation, the numbers of endogenous bifidobacteria that inherently colonized the intestine of the mice also increased. Control food supplemented with source or starch decomposition products had no apparent effect.

Bifidobacteria in the intestine produces lactic acid by fermentation of carbohydrates. These bacteria suppress the growth of pathogenic bacteria and prevent putrefaction in the intestine, and therefore are regarded to be beneficial to health. Bifidobacteria are known to utilize ingested oligosaccharides as a nutrient source and proliferate more selectively than other bacteria. For this reason, various types of health foods con-

taining oligosaccharides are sold on the market.

Some microbiologists assert that for promotion of bifidobacterial proliferation satisfactory results are obtained by feeding other types of carbohydrates such as galactose or glucose, and that it is doubtful whether oligosaccharides actually provide the desired effect in the intestines. The experiments conducted this time have proven the effectiveness of oligosaccharides.

In these experiments, mice were given *Bifidobacterium longum* M97 orally, an antibiotic-resistant (tetracycline-resistant) strain isolated from a healthy human ( $7.3-8.3 \times 10^{10}$  colony forming units per mouse). The number of these bacteria in the feces of the mice was measured using an agar culture medium containing tetracycline. Liquid food supplemented with oligosaccharides (raffinose or lactulose), sucrose, or dextrin was supplied to the mice ad libitum using sterile bags and the effects of the administered carbohydrates were examined in comparison with the control liquid food which contained no lactose.

In the groups of mice fed the pelleted diet, liquid food supplemented with sucrose or dextrin, no proliferation of bifidobacteria, neither the strain inoculated nor those that inherently colonized the mice, was observed. On the other hand, both of these kinds of bifidobacteria proliferated predominantly in the mice fed the liquid food supplemented with raffinose or lactulose. From these results, it was confirmed that bifidobacteria became dominant among intestinal bacteria as a result of ingestion of oligosaccharides blended into liquid foods which contained no lactose.

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### Soft Electron Beam Sterilization Technique for Grains and Spices

The National Food Research Institute of the Ministry of Agriculture and Forestry has developed a new grain and spice sterilization system by devising a new

sterilization technique using low-energy electron beams. This new sterilization system has been confirmed to kill various types of microorganisms on the surfaces of grains and spices almost completely without degrading the quality. This type of sterilization system that hardly affects the treated products is the first in the trade, and is also applicable to the manufacture of all kinds of processed foods.

The newly developed sterilization system is called Soft Electron. Electron beams of low energy levels of less than 300,000 electron volts (300 keV) are defined as soft electron beams. This is the energy level at the outlet of an electron beam generator, so the electron energy at a position about 17 cm away from the beam generator where the grain is irradiated will be 60,000-200,000 electron volts (60-200 keV). Virtually all types of foods can be sterilized with an electron beam of 60-150 keV, which is the same electron energy level as that of an electronic microscope, so Soft Electron can be handled in the same manner as an electronic microscope.

The grains are irradiated simultaneously with vertical and lateral vibrations while in motion to apply the electron beam uniformly on their surfaces. With grains, beans and spices, microorganisms proliferate on the surfaces, and a soft electron beam penetrates only to a depth of 50-100  $\mu\text{m}$  into these targets. Therefore, as long as the surfaces are sterilized, these targets will be made microorganism-free.

Soft Electron features the minimum permeation necessary for sterilization, but since the beam does not penetrate further inside, the quality is little affected. Also, when applied to unpolished rice, unhulled rice and unhulled buckwheat, the parts irradiated with Soft Electron are removed when husking or polishing them, so the polished rice and wheat will have the same qualities as those which are untreated.

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